Five-Year Review Report

Second Five-Year Review Report

for Moss-American Site

Milwaukee, Wisconsin

September 2005

PREPARED BY:

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Russell Hart, RPM
Region 5 - Chicago

Approved by:

Richard C. Karl, Director
Superfund Division

Date:

9-20-05

Five-Year Review Report

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List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
BTEX	Benzene, Toluene, Ethyl Benzene, and/or Xylene(s)
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPAH	Carcinogenic Polycyclic Aromatic Hydrocarbon(s)
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference
LTTD	Low Temperature Thermal Desorption
MCL	Maximum Contaminant Level
MA	Management Assistance
NCP	National Contingency Plan
NPL	National Priorities List
NR	Wisconsin Natural Resources rule citation
O&M	Operation and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon(s)
PRP	Potentially Responsible Party
RA	Remedial Action
RAO	Remedial Action Objective
RCL	Residual Cleanup Level
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SDWA	Safe Drinking Water Act
UU/UE	Unlimited Use/Unrestricted Exposure
VOC	Volatile Organic Compound
WDNR	Wisconsin Department of Natural Resources

Executive Summary

The United States Environmental Protection Agency (U.S. EPA), Region 5, conducted the five-year review of the remedy being implemented at the Moss-American Superfund Site in Milwaukee, Wisconsin. This is the second five-year review for the Moss-American Site. In 2000, U.S. EPA certified that the remedies selected for this site remain protective of human health and the environment.

With the passage of five years since the first such review, a second Five Year Review is now required. This second review will examine significant site developments over the past five years. Significant site developments include operation of the funnel and gate groundwater collection and treatment system, remedial design development and remedial action which provided for the low temperature thermal desorption treatment of approximately 137,000 tons of more highly contaminated site soils, the filing of necessary deed instruments to recognize the industrial nature of significant portions of the site, and the remedial design development and remedial action of sediment management within three of the five affected Little Menomonee River stream segments.

In 1921, the T. J. Moss Tie Company established a wood preserving facility west of the Little Menomonee River. The plant preserved railroad ties, poles, and fence posts with creosote, a mixture of numerous chemical compounds, derived from coal tar. Site creosote operations were conducted from approximately 1921 to 1976. From 1921 to 1971, the facility discharged wastes to settling ponds that ultimately discharged to the Little Menomonee River. Kerr-McGee purchased the facility in 1963 and changed the facility's name to Moss-American. The name was changed again in 1974 to Kerr-McGee Chemical Corporation - Forest Products Division. In 1998, the name of this company changed to Kerr-McGee Chemical LLC (KMC). Under WDNR order, KMC cleaned out eight former settling ponds and dredged about 1,700 feet of river to remove creosote-contaminated soil and sediment. During 1972 to 1973, three different dredging efforts were conducted in the Little Menomonee River within the first mile downstream of the facility.

In 1983, the facility was proposed for inclusion on the National Priorities List (NPL) pursuant to Section 105 of CERCLA. Remedial Investigation findings indicated that for site soils most of the contamination was associated with former creosote processing areas such as application areas, near former settling ponds, and in the vicinity of treated wood storage areas, where some drippage of applied substances can occur. A class of contaminants known as polycyclic aromatic hydrocarbons, or PAHs, constututed the primary contaminants of concern at the site. In addition to soils contamination, site groundwater and sediments downstream of the site were also found to be contaminated.

After evaluation of public comment, U.S. EPA selected a remedy for the site as embodied in the Record of Decision (ROD) signed on September 27, 1990. The remedy consisted of components to deal with contaminated site soils, Little Menomonee River sediments, and site groundwater.

Following ROD development, U.S. EPA entered into discussions with potentially responsible parties. On December 30, 1991, the United States lodged a consent decree with the Federal District Court for the Eastern District of Wisconsin in Milwaukee. This Consent Decree, which was signed by U.S. EPA, the State of Wisconsin and KMC, required KMC to implement the Remedial Design and Remedial Action set forth in the ROD. The Court entered the Consent Decree in 1996, after EPA resolved its past costs claims with Union Pacific and the County of Milwaukee, and the County withdrew its objections to the Consent Decree.

In April 1997, U.S. EPA signed, with WDNR concurrence, an Explanation of Significant Difference (ESD) concerning site contaminated groundwater collection and treatment. The ESD provided allowance for groundwater treatment via a funnel and gate system. Basically, a funnel and gate system would redirect groundwater flow through usage of sheet piling driven into a silty clay till confining soil layer underneath the contaminated aquifer. Sections of piling would be interconnected and sealed. Engineered soil media (gates) would be introduced so as to preferentially direct groundwater flow. Treatment would be accomplished by introducing air and nutrients in-situ in the zones of preferential groundwater flow so as to bring about the biological reduction of the groundwater contaminants.

In September 1998, U.S. EPA issued a ROD Amendment which dealt primarily with site soils. WDNR conditionally concurred with this amendment. The ROD Amendment provided for use of thermal desorption as a treatment technology to deal with more highly contaminated site soils. EPA now considers thermal desorption a presumptive remedy for wood preservative treatment sites.

While the Moss-American site consists of one overall operable unit, work actually has gone on in a series of phases, each dealing predominantly with a given environmental media. Both Remedial Investigation and pre-design efforts indicated the presence of free product in some wells. From 1995-1998, extraction wells were operated to collect and remove this free product creosote, which would otherwise have interfered with both groundwater and site soil remediation attempts. The funnel and gate system was installed during 1999-2000. Thermal desorption soil treatment efforts were conducted from mid-2001 to early 2002. Sediment management efforts in Segment 1 were begun in the late summer of 2002, and completed by mid-winter of 2003. Sediment management remediation for stream Segments 2 and 3 began in early 2004, and were finished at the end of that year.

The remedy is functioning as intended and is expected to be protective upon completion of the remedy. Long term protectiveness requires achievement of groundwater cleanup standards, sediment cleanup standards, and the recording, monitoring and compliance with institutional controls.

Construction has been completed for soils treatment and the groundwater funnel and gate system only. Sediment management is not yet complete for the final two stream segments, Segments 4 and 5.

Therefore, while all immediate threats have been eliminated, the remedy is expected to be protective upon completion of all remedial measures.

The remedy implemented for soils treatment via low temperature thermal desorption, and the funnel and gate groundwater collection/treatment system, is protective of Human Health and the Environment, all immediate health threats have been addressed, and there are no exposures of concern. For the groundwater funnel and gate system, the parties have identified a pocket of contaminated groundwater in between active gate areas as an issue, and will explore options in trying to enhance the efficiency of capture of this "pocket" of contamination. However, this desire to improve system efficiency does not mean that the groundwater funnel and gate system is not protective of overall remedial goals. The soils and groundwater management portions of the overall site remedy are protective.

For sediment management, the remedy is expected to be protective upon completion. Initial review of work to date in completed Segments 1-3 indicate that remedial goals for PAH cleanup in the stream bed has been attained, and the desirable features, such as pools and riffle areas, that were introduced into new channel areas, appear well established. Continued observation and care must be taken with regard to revegetation survival rates, and control of invasive species. However, initial results for Segments 1-3 also appear encouraging in this regard. The technologies selected for sediment management appear to be protective of human health and the environment. Once design is complete, and all stream sediment management remedial technologies are installed and operating, a following review report can deal more definitively with the degree of success of the sediment management efforts.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Moss-American Site		
EPA ID *(from WasteLAN)*: WID039052626		
Region: 5	**State:** Wisconsin	**City/County:** Milwaukee/Milwaukee

SITE STATUS	
NPL status: XX Final Deleted ☐ Other (specify)	
Remediation status (choose all that apply): Under Construction XX Operating ☐ Complete	
Multiple OUs?* ☐ YES XX NO	**Construction completion date:**
Has site been put into reuse? XX☐ YES ☐ NO	

REVIEW STATUS	
Lead agency: XX EPA ☐ State ☐ Tribe ☐ Other Federal Agency	
Author(s) name: Russell D. Hart	
Author(s) title: Remedial Project Manager	**Author(s) affiliation:** U.S. EPA, Region 5
Review period: January 2005 to September 2005	
Date(s) of site inspection: June 28, 2005	
Type of review: X Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion	
Review number: 1 (first) XX 2 (second) ☐ 3 (third) ☐ Other	
Triggering action: ☐ Actual RA Onsite Construction at OU #_____ ☐ Actual RA Start at OU#____ Construction Completion (PCOR) XX Previous Five-Year Review Report ☐ Other (specify)	
Triggering action date *(from WasteLAN)*: September 18, 2000	
Due date *(five years after triggering action date)*: September 18, 2005	

["OU" refers to operable unit.]

Five-Year Review Summary Form, cont'd.

Issues:

1. More efficient operation of the funnel and gate groundwater system

2. PRP representatives raise the matter of modifying/streamlining the groundwater monitoring network for enhanced optimization.

3. Present/future institutional controls need to be evaluated and executed to ensure protectiveness of the remedial action.

4. Evaluate whether a strip of land immediately south of Brown Deer Road and north of the Union Pacific Railroad tracks which may not have been subject to active creosote plant operations should be included within the RD/RA Consent Decree.

5. Two or three monitoring wells associated with treatment gate zone #1 appeared to have undergone some subsidence, to the extent that the well casing may need to be re-sealed.

Recommendations and Follow-up Actions:

1. Funnel and Gate System - The treatment capacity of the final two gates is at present underutilized. The gradient in this area of the aquifer is very slight, such that it may be some time before contaminated groundwater near wells MW-33/34 reaches the final gate pairs. Could another treatment gate be installed near this point of higher aquifer contamination? Could flow be induced to move towards the final two gate pairs, either by extracting water near those gates, or injecting it back near the MW-33/34 vicinity? If trees were planted near the final two gate pairs, could they serve as "natural pumps" in drawing water towards this area, and better use the treatment capacity? The parties may not be able to resolve this matter before issuance of this report, but the parties will continue to consider whether and how the aquifer cleanup question may be managed more efficiently.

2. Optimizing Groundwater Monitoring Network - U.S. EPA is aware of developing guidance in this area, and is cognizant of the need to make adjustments towards "long term monitoring optimization". U.S. EPA will review this matter in coordination with WDNR. As with the previous issue, a final decision may not necessarily be reached prior to issuance of this report, but the agencies will continue to consider this item.

3. Institutional Controls. EPA and/or the parties need to examine the institutional controls currently in place to determine whether they are adequate, protective, in effect on the appropriate properties, enforceable and run with the land. Kerr McGee has observed that the parties revisited

land use controls and executed revised and expanded proprietary controls in 2000, but there is currently no analysis of what restrictions were recorded on what specific properties, whether other interests in the particular property (e.g. pre-existing easements) need to be subordinated, whether title commitments are needed and whether there are properties at the site that do not have restrictions in place. U.S. EPA will explore this issue with other parties.

4. Uncontaminated Strip of Land - In coordination with WDNR, U.S. EPA will consider this issue. Discussion with U.S. DOJ may prove warranted. A letter developed by the parties bound to the RD/RA Consent Decree, and clarifying whether the Decree should properly include/exclude such land may be appropriate.

5. Well Casing - Well casing construction should be such that one avoids the well serving as a conduit for surface water infiltration. This was discussed in the field with KMC/Weston representatives, and it is EPA's impression that all parties agree this is a needed maintenance item.

Protectiveness Statement(s): The remedy is functioning as intended and is expected to be protective upon completion of the remedy. Long term protectiveness requires achievement of groundwater cleanup standards, sediment cleanup standards, and the recording, monitoring and compliance with institutional controls.

Construction has been completed for soils treatment and the groundwater funnel and gate system only. Sediment management is not yet complete for the final two stream segments, Segments 4 and 5.

Therefore, while all immediate threats have been eliminated and there are no current exposures or threats to human health and the environment, the remedy is expected to be protective upon completion of all remedial measures.

The remedy implemented for soils treatment via low temperature thermal desorption, and the funnel and gate groundwater collection/treatment system, is protective of Human Health and the Environment, all immediate health threats have been addressed, and there are no exposures of concern. For the groundwater funnel and gate system, the parties have identified a pocket of contaminated groundwater in between active gate areas as an issue, and will explore options in trying to enhance the efficiency of capture of this "pocket" of contamination. However, this desire to improve system efficiency does not mean that the groundwater funnel and gate system is not protective of overall remedial goals. The soils and groundwater management portions of the overall site remedy are protective.

For sediment management, the remedy is expected to be protective upon completion. Initial review of work to date in completed Segments 1-3 indicate that remedial goals for PAH cleanup in the stream bed has been attained, and the desirable features, such as pools and riffle areas, that were introduced into new channel areas, appear well established. Continued observation and

care must be taken with regard to revegetation survival rates, and control of invasive species. However, initial results for Segments 1-3 also appear encouraging in this regard. The technologies selected for sediment management appear to be protective of human health and the environment. Once design is complete, and all stream sediment management remedial technologies are installed and operating, a following review report can deal more definitively with the degree of success of the sediment management efforts.

Five-Year Review Report

I. Introduction

The purpose of the five-year review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to CERCLA § 121(c), 42 U.S.C. § 9621(c), and the National Contingency Plan (NCP). CERCLA § 121(c) states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at such site in accordance with Section 104 or 106, the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The Agency interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above such levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

The United States Environmental Protection Agency (U.S. EPA), Region 5, conducted the five-year review of the remedy implemented at the Moss-American Superfund Site in Milwaukee, Wisconsin. This review was conducted by the Remedial Project Manager (RPM) for the entire site from January 2005 through September 2005. This report documents the results of the review.

This is the second five-year review for the Moss-American Site. The triggering action for this review is the September 18, 2000, signature of the first five-year review report. This review will examine significant site developments over the past five years. Significant site developments include operation of the funnel and gate groundwater collection and treatment system, remedial design development and remedial action which provided for the low temperature thermal desorption treatment of approximately 137,000 tons of more highly contaminated site soils, the filing of necessary deed instruments to recognize the industrial nature of significant portions of the site, and the remedial design development and remedial action of sediment management within three of the five affected Little Menomonee River stream segments.

As of the present time, hazardous substances remain on the Moss-American site which preclude unlimited use and unrestricted exposure.

II. Site Chronology

Table 1: Chronology of Site Events

Event	Date
NPL inclusion proposal	**September 8, 1983**
NPL finalization	**September 21, 1984**
RI/FS Negotiations	**Began 8/15/1985; ended 9/30/1985**
RI/FS field investigation	**Began 9/30/1985. RI report completed January 9, 1990; FS report completed May 24, 1990**
Proposed Plan	**May 29, 1990**
Record of Decision	**September 27, 1990**
Explanation of Significant Difference (ESD)	**Signed 4/29/1997**
ROD Amendment	**Signed 9/30/1998**
Remedial Design Elements	**free product - final design approved 5/19/1995** **funnel/gate - design approved 9/29/1999** **LTTD (soils) - design approved 3/8/2000** **Sediment - Segment 1 - final design approved 9/5/2002** **Sediment - Segments 2/3 - final design approved 2/25/2004**
Remedial Action Construction - Groundwater Remedial Action Construction - Soils	**funnel/gate installed Nov. 1999- June 2000** **LTTD conducted May 2001- Jan. 2002**

Table 1: Chronology of Site Events

Event	Date
First Five Year Review Report Public Notice of Second Five Year Report Prep.	**Signed September 18, 2000** **February 22, 2005**
Site Inspection (for second review)	**June 28, 2005**
Second Five Year Review Report	**September 2005**

III. Background

Physical Characteristics and Site Description

Land and Resource Use

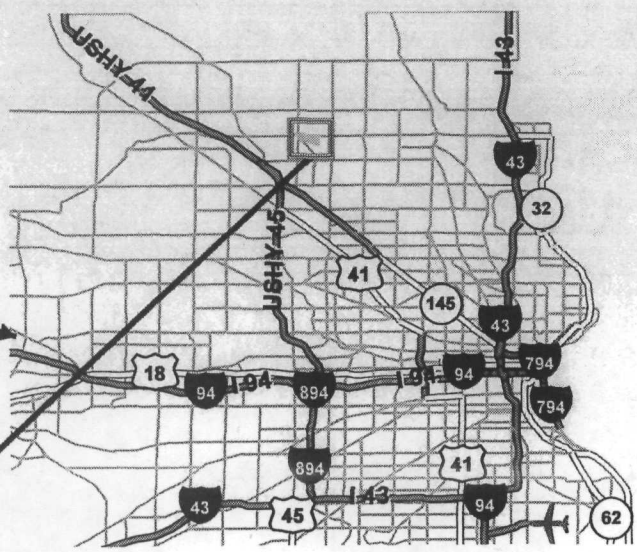
The Moss-American site is located in the northwestern section of the City of Milwaukee. Eighty eight acres of the site are comprised of a former creosoting facility location, plus several miles of the Little Menomonee River and its adjacent floodplain soils. The former creosote operation was conducted on land bounded roughly by the intersection of Brown Deer and Granville Roads on the west, and Brown Deer and Ninety First Street on the east. With the cessation of creosote operations, twenty three acres of site land are now owned by the Union Pacific Railroad, which until very recently used this land as an automobile/light truck loading and storage area. Recent business conditions curtailed most of the vehicle storage/transfer function. However, site zoning and industrial usage of this portion of the site remain intact. Milwaukee County owns the remainder of the land comprising the former creosote facility. As the Little Menomonee River flows approximately 5 miles to its confluence with the Menomonee River, land along the floodplain corridor is owned primarily by the City of Milwaukee, County of Milwaukee, and to a much lesser extent, private owners.

Site creosote operations were conducted from approximately 1921 to 1976. A look at past site aerial photos shows that land usage patterns have changed considerably with the passage of time. Photos from the 1930s to the 1950s show the creosote plant operating in a relatively sparsely populated setting, where several farms surrounded the manufacturing operation. From the 1960s on to the present, residential and commercial use of nearby property has increased considerably, and agricultural and farming operations have been almost completely phased out. Industrial parks and multi-lane highways also traverse the site setting. County owned land along the river corridor has featured installation of hiking and bicycle trails, so as to emphasize recreational opportunities. These features have had a direct bearing on site soil cleanup standards, and have

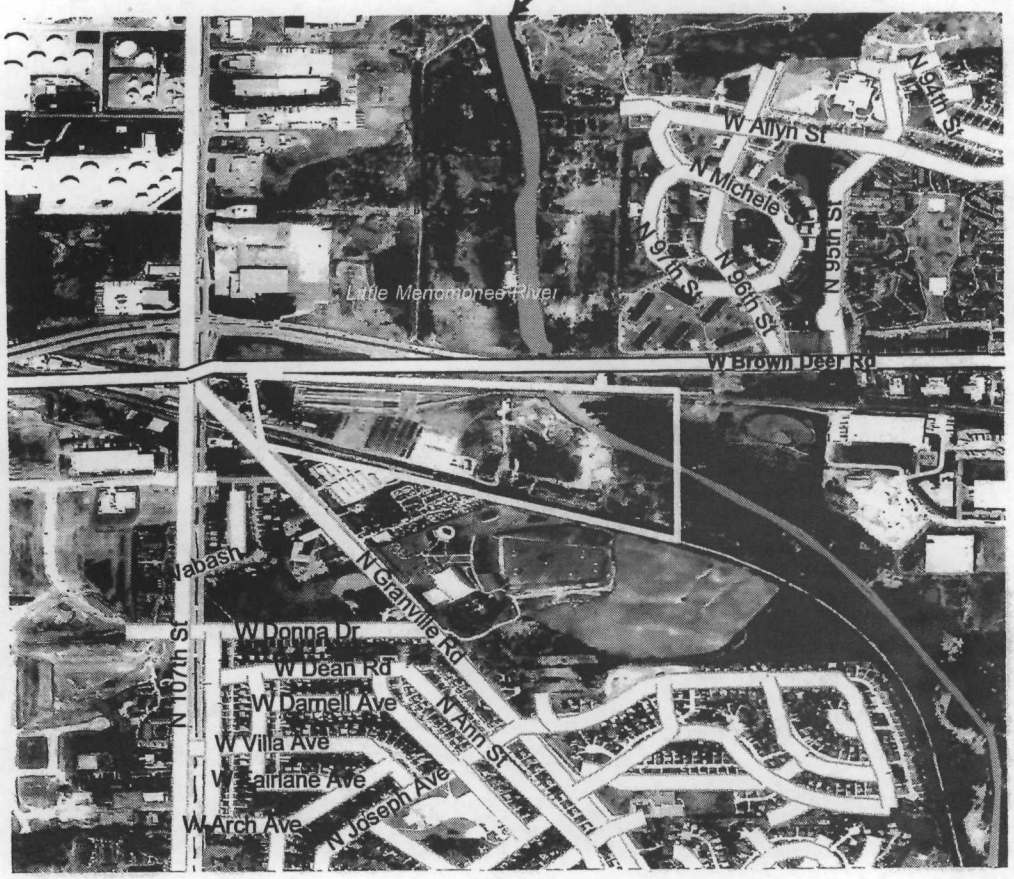
Former Moss-American Production Area

1) State

2) Milwaukee County



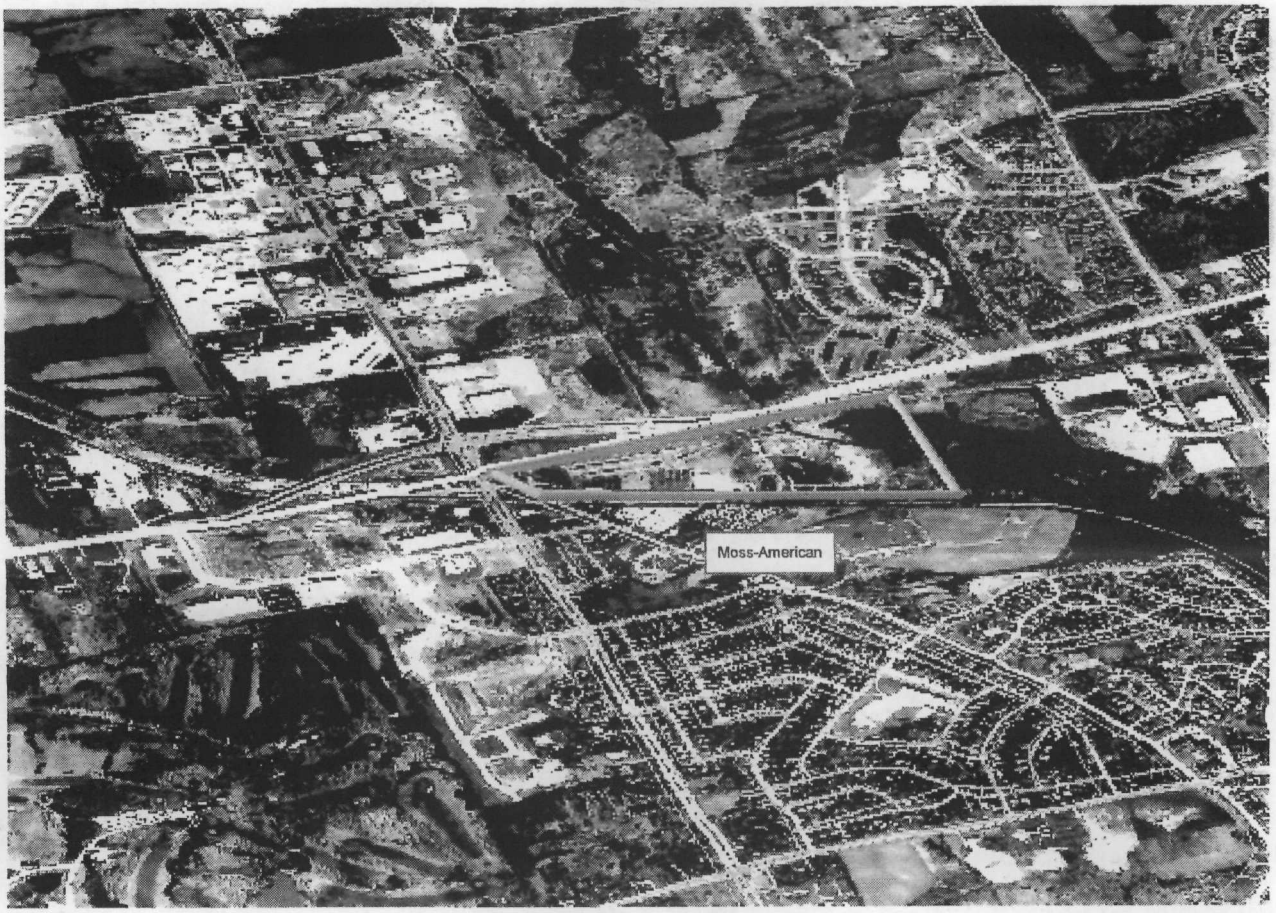
3) Moss-American



Plot created by Sarah Backhouse U.S. EPA Region 5 on 9/7/2005

GEOS
Groundwater Evaluation and Optimization System

Former Moss-American Production Area
3D Surface Terrain Model



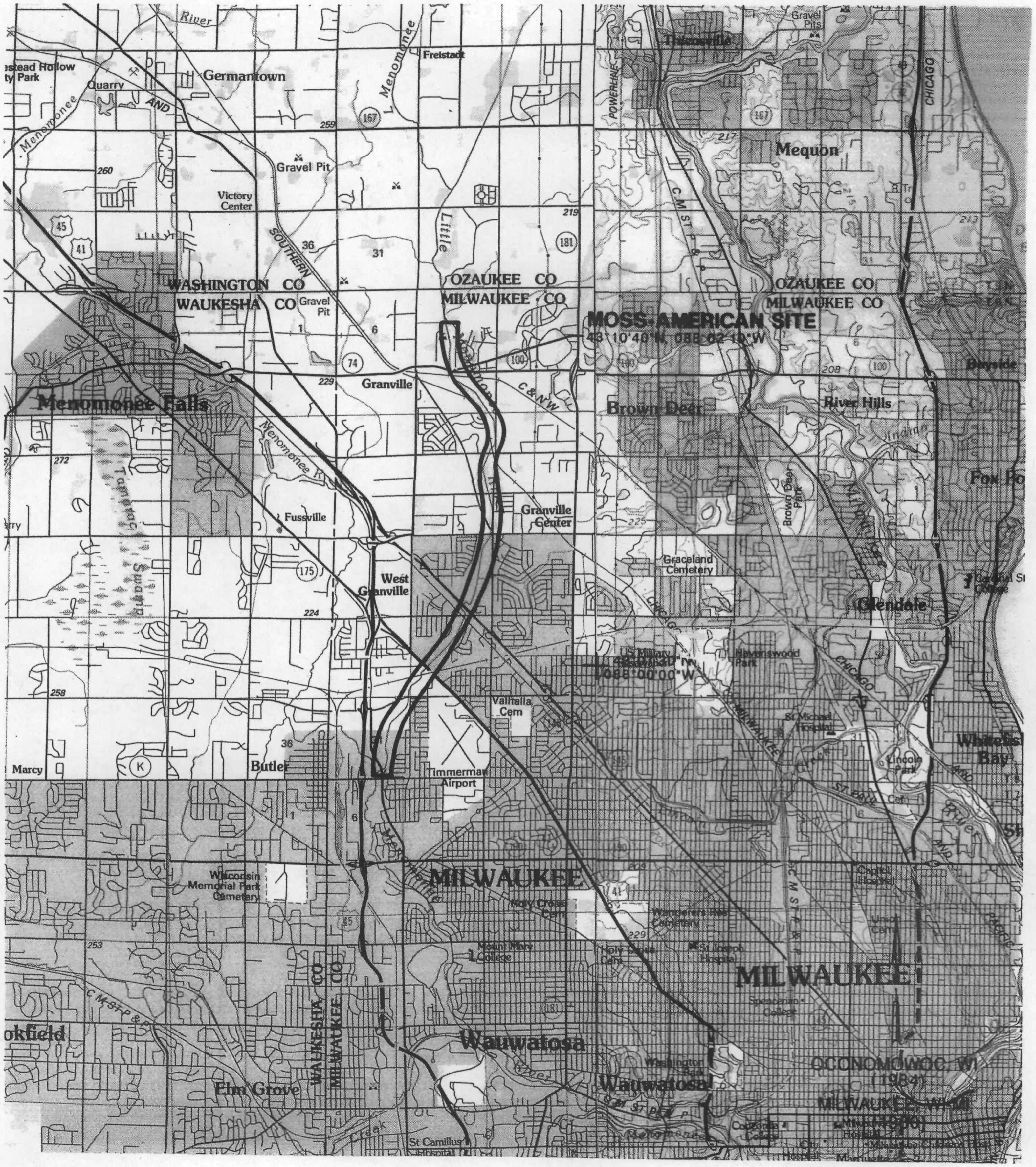
Elevation Feet

- 903 - 932
- 873 - 903
- 844 - 873
- 814 - 844
- 785 - 814
- 755 - 785
- 726 - 755
- 696 - 726
- 667 - 696

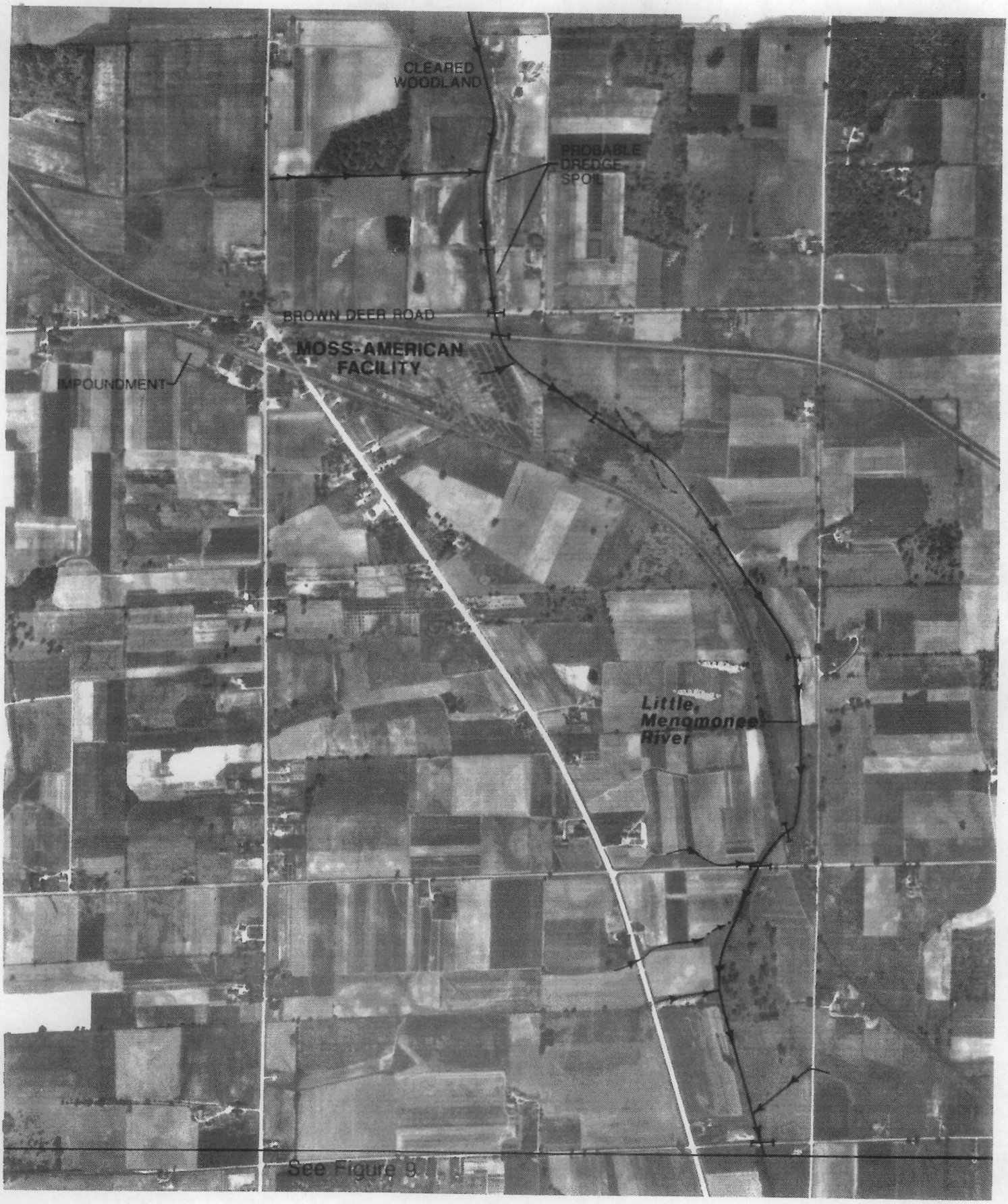
GEOS
Groundwater Evaluation and Optimization System

Plot created by Sarah Backhouse U.S. EPA Region 5 on 9/7/2005

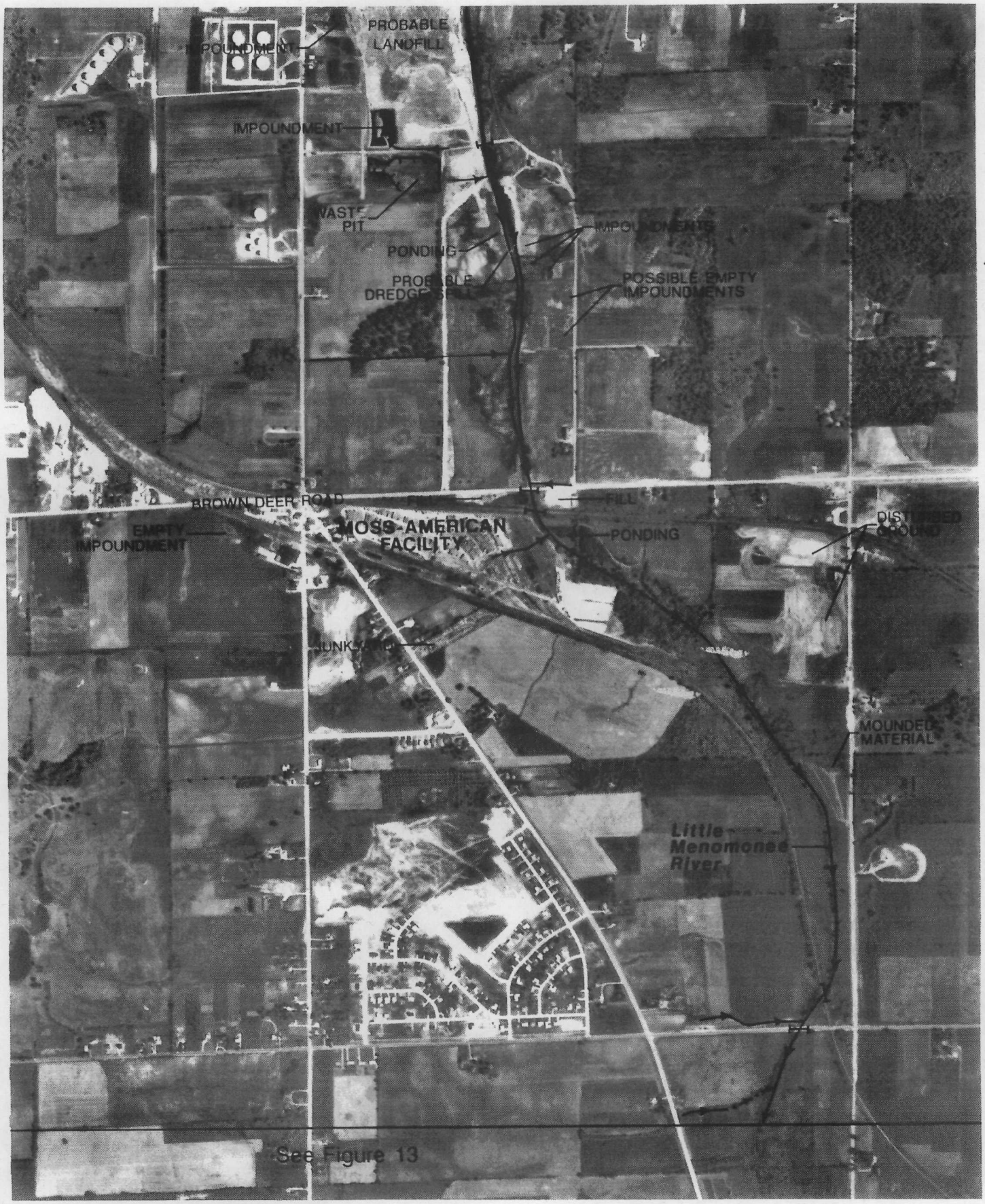

Sand
Apostle Islands
Madeline Island
Superior
Washburn
Ashland
Hurley
BAYFIELD
DOUGLAS
IRON
ASHLAND
Hayward
WASHBURN
BURNETT
SAWER
Grantsburg
Shell Lake
Phillips
PRICE
ONEIDA
Eagle River
Florence
FLORENCE
FOREST
Crandon
Rhinelander
POLK
BARRON
RUSK
Balsam Lake
Barron
Ladysmith
LINCOLN
LANGLADE
OCONTO
MARINETTE
TAYLOR
Merrill
Antigo
Medford
Stillwater
DUNN
CHIPPEWA
ST CROIX
Hudson
Chippewa Falls
Wausau
MENOMINEE
Keshena
Oconto
Marinette
MARATHON
SHAWANO
Shawano
Sturgeon Bay
Menomonie
Eau Claire
Ellsworth
PIERCE
EAU CLAIRE
CLARK
Durand
Neillsville
Stevens Point
WOOD
PORTAGE
WAUPACA
OUTAGAMIE
BROWN
Green Bay
Kewaunee
BUFFALO
Alma
Whitehall
JACKSON
Wisconsin Rapids
Waupaca
Appleton
Black River Falls
TREMPEALEAU
MISSISSIPPI
Black
WINNEBAGO
CALUMET
Wautoma
Manitowoc
MONROE
Friendship
WAUSHARA
Oshkosh
Chilton
Sparta
ADAMS
Montello
Green Lake
Fond du Lac
Sheboygan
La Crosse
Mauston
FOND DU LAC
SHEBOYGAN
VERNON
Viroqua
Portage
Baraboo
MOSS-AMERICAN SITE
RICHLAND
SAUK
Port Washington
CRAWFORD
Richland Center
DODGE
Wisconsin
River
DANE
JEFFERSON
WAUKESHA
MILWAUKEE
Prairie du Chien
IOWA
MADISON
Jefferson
Waukesha
GRANT
Dodgeville
Lancaster
GREEN
ROCK
WALWORTH
RACINE
Racine
Darlington
Janesville
Elkhorn
Monroe
LAFAYETTE
KENOSHA
Kenosha
MICHIGAN
-N-
UNITED STATES
(1972)


MOSS-AMERICAN SITE
43°10'40"N, 088°02'10"W
Germantown
Freistadt
Thiensville
Mequon
Gravel Pit
Victory Center
WASHINGTON CO
WAUKESHA CO
OZAUKEE CO
MILWAUKEE CO
Granville
Menomonee Falls
Brown Deer
River Hills
Bayside
Fussville
Granville Center
West Granville
Graceland Cemetery
Glendale
Brown Deer Park
Havenswood Park
Valhalla Cem
Timmerman Airport
Butler
Marcy
MILWAUKEE
Wisconsin Memorial Park Cemetery
Holy Cross Cem
Mount Mary College
St Joseph Hospital
Wauwatosa
Elm Grove
WAUKESHA CO
MILWAUKEE CO
Washington Park
Concordia College
St Camillus Hospital
Lincoln Park
Whitefish Bay
Union Cem
OCONOMOWOC, WI
(1984)
Tamarack Swamp
St Michael Hospital
Capitol Hospital
Wanderers Rest Cemetery

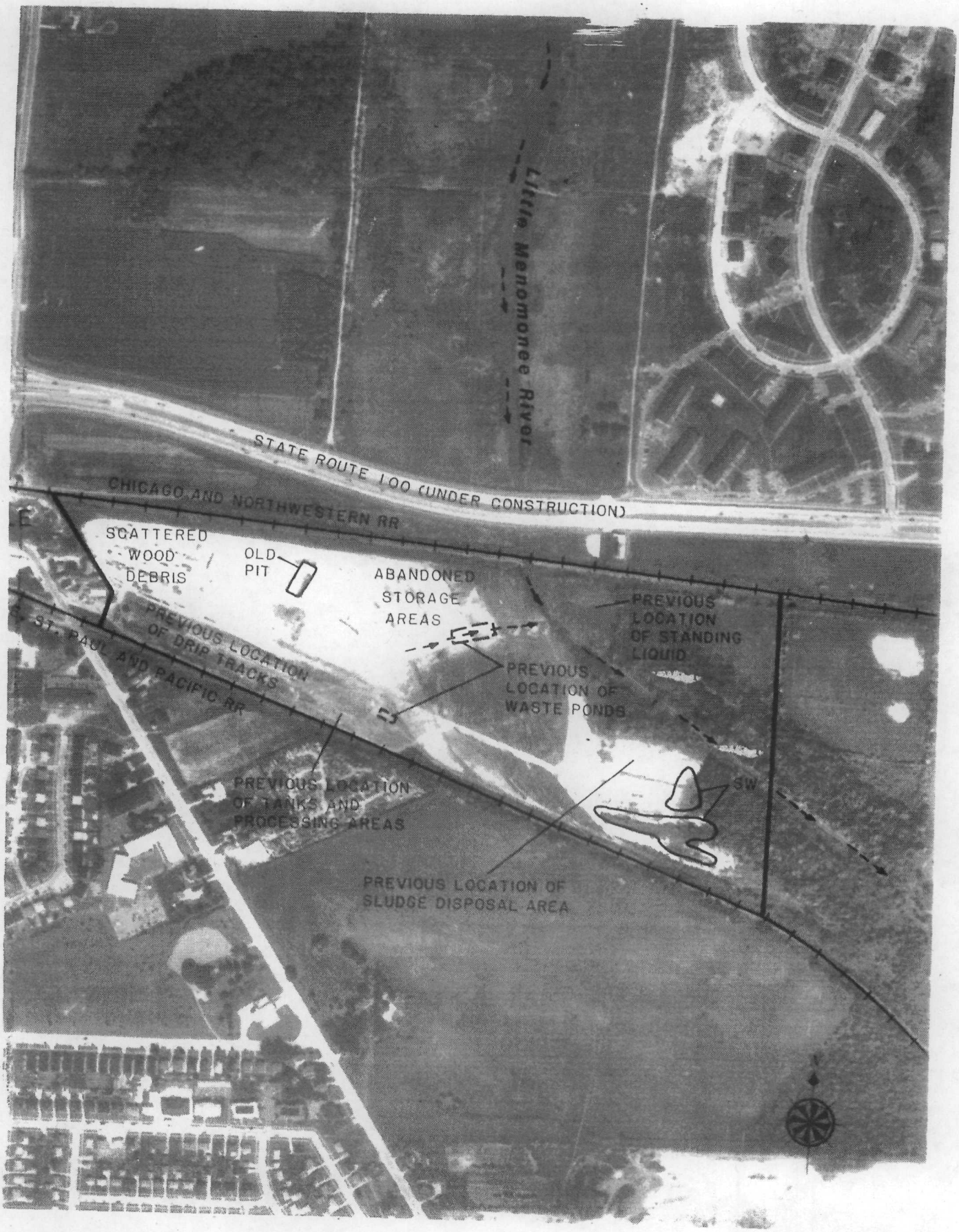
Moss-American, October 25, 1941, (1 of 3). Approximate Scale 1:16,000.



-American, September 6, 1950, (1 of 3). Approximate Scale 1:15,000.

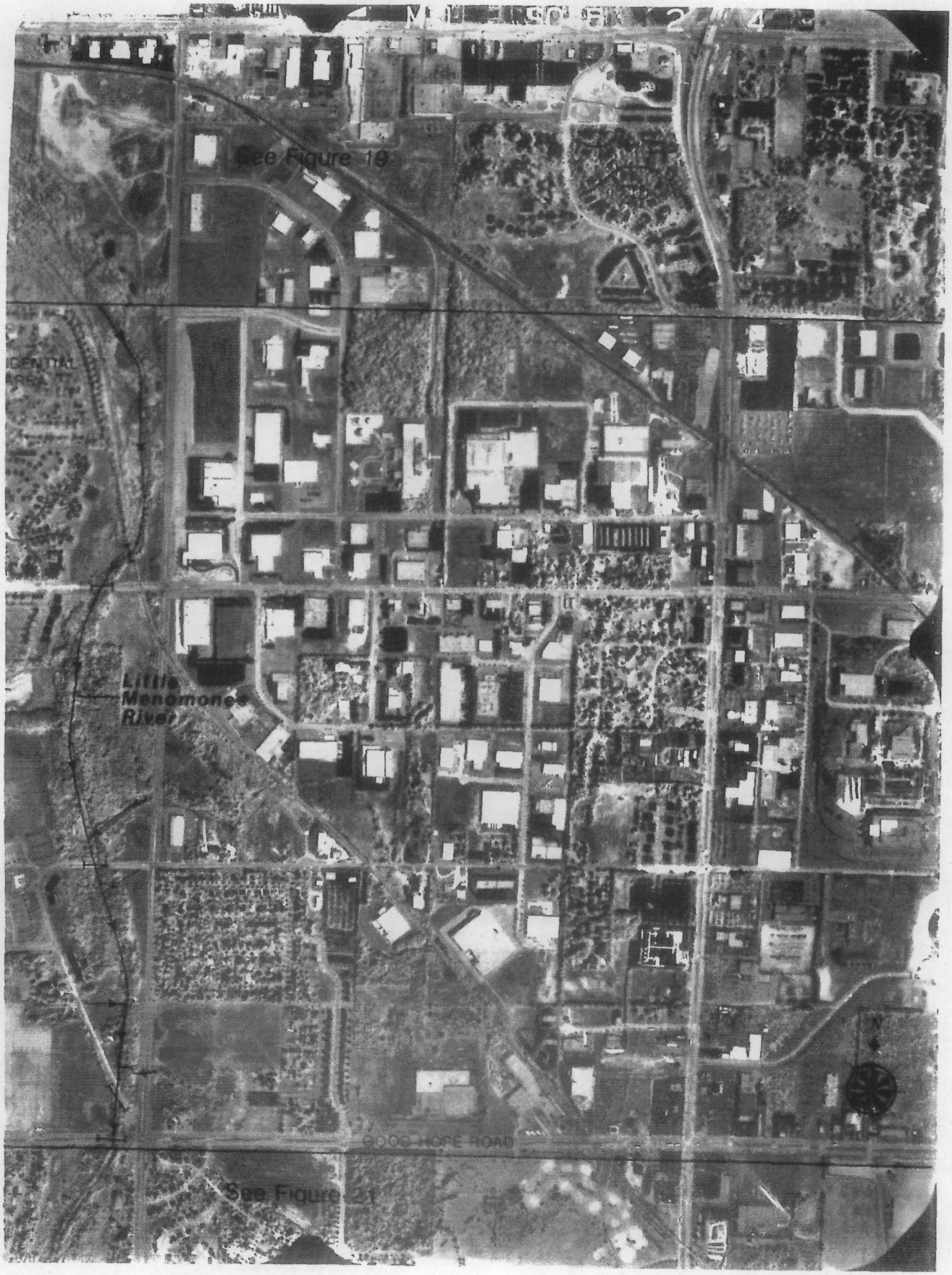


-American, June 13, 1969, (1 of 3). Approximate Scale 1:15,500.



-American Co., Inc. (Kerr-McGee Oil Co.), September 22, 1979.
oximate scale 1:5,750.

erican, August 11, 1992, (1 of 4). Approximate Scale 1:16,000.



n, August 11, 1992, (2 of 4). Approximate Scale 1:16,000.

., August 11, 1992, (3 of 4). Approximate Scale 1:16,000.

2. Moss-American, August 11, 1992, (4 of 4). Approximate Scale 1:16,000.

influenced sediment remediation to try to combine natural resource recovery along with particular sediment cleanup goals.

Contamination History

In 1921, the T. J. Moss Tie Company established a wood preserving facility west of the Little Menomonee River. The plant preserved railroad ties, poles, and fence posts with creosote, a mixture of numerous chemical compounds, derived from coal tar. While No. 6 fuel oil was also used, no evidence of pentachlorophenol use was found at the Moss-American site. Creosote plant operations often contain storage facilities for creosote and fuels, a boiler for making steam, heating the creosote and applying the creosote to the wood, areas for unloading and storing incoming timbers, rail cars for transporting the creosote, and a drying area for subsequent storage. Potential for release of materials exists throughout the storage, application, and drying processes.

Kerr-McGee purchased the facility in 1963 and changed the facility's name to Moss-American. The name was changed again in 1974 to Kerr-McGee Chemical Corporation - Forest Products Division. In 1998, the name of this company changed to Kerr-McGee Chemical LLC (KMC).

From 1921 to 1971, the facility discharged wastes to settling ponds that ultimately discharged to the Little Menomonee River. These discharges ceased when the plant diverted its process water discharge to the Milwaukee sanitary sewerage system. Production at the facility ceased in 1976.

Under WDNR order, KMC cleaned out eight former settling ponds and dredged about 1,700 feet of river to remove creosote-contaminated soil and sediment. In the period from 1972 through 1973, three different dredging efforts were conducted in the Little Menomonee River within the first mile downstream of the facility.

Initial Response

In 1983, the facility was proposed for inclusion on the National Priorities List (NPL) pursuant to Section 105 of CERCLA. In 1985, U.S. EPA initiated a negotiation period with potentially responsible parties (PRPs) associated with the site to determine if they would conduct the Remedial Investigation/Feasibility Study (RI/FS). When those discussions did not result in a settlement, U.S. EPA conducted the RI/FS.

RI findings indicated that for site soils most of the contamination was associated with former creosote processing areas such as application areas, near former settling ponds, and in the vicinity of treated wood storage areas, where some drippage of applied substances can occur. PAH contamination ranged as high as 32000 mg/kg in soils. Benzene - toluene - ethyl benzene - xylene compounds (sometimes denoted as "BTEX" substances), also were detected in soils, at levels ranging from 0.02 mg/kg to 17 mg/kg. Most soil contamination occurred within the upper 10 feet of soil.

The RI revealed indications of free product liquids associated with site groundwater. Contaminants, consisting chiefly of PAHs and BTEX compounds, occurred principally in shallow monitoring wells. Little or no groundwater contamination was detected deeper than 20 feet below ground surface. The main plume of groundwater contamination appeared to occur in the central portion of the former processing area, in a band approximately 600 feet across. Shallow groundwater at the site was believed to be discharging into the Little Menomonee River.

Sediment samples from the Little Menomonee River were collected and analyzed at intervals running from a point near Brown Deer Road to the confluence of the Little Menomonee River with the Menomonee River, located some 5.5 to 6 miles downstream from the former creosote processing facility. While there was considerable variation in sample results, at least 12 sediment samples exceeded 100 mg/kg or greater of carcinogenic PAH (CPAH) compounds. Background levels of CPAH substances was initially put at 18 mg/kg; but this value has been refined somewhat in a subsequent study.

Basis for Taking Action

In considering risks that may be posed to human health and the environment, a baseline risk assessment was conducted as part of the RI effort for the Moss-American site. Major site contaminants fall into such chemical groups as PAHs and BTEX compounds. PAHs are a primary component of creosote blends, and in terms of health effects have been associated with lung, stomach, and skin cancers. PAH compound structure is in varying complexity of connected hexagonally shaped rings. Carcinogenicity has been associated with some of the more complex 4 and 5 ring PAH compounds; benzo[a]pyrene is one such example. As for the BTEX compounds, benzene has been associated with occurrences of leukemia, while toluene and xylenes appear to cause depression of the human central nervous system.

In considering the types of personnel who might be exposed to site soils, and the levels of site contaminants within such soils, the RI risk assessment calculated a risk of five times the 10^{-4} value considered to be an acceptable upper limit for casual site users. Potential users with more frequent instances of exposure would have faced higher risks.

In considering exposure to site sediments, the RI risk assessment noted that risk varied somewhat in each of the stream "segments" moving downstream from the former creosote processing area. (Note - in this instance, the term "segment" denotes a major east-west highway bridge over the river at approximately one to one and a quarter mile intervals). Sediment exposure risks to humans tended to be higher in segments 1, 2, and 3 - on the order of 10^{-4} excess carcinogenic risk due to CPAH exposure. In river segments 4 and 5, the excess carcinogenic risk dropped to 5 and 3 times 10^{-5}, respectively. Based on human exposure alone, exposure to CPAHs via sediment presented excess risk at the upper (10^{-4}) acceptable range of the risk range (10^{-6} to 10^{-4}) sought by U.S. EPA for remedial sites. However, when coupled with perceived risk to aquatic habitat, sediments were also viewed as an environmental medium that presented an unacceptably high risk pathway. While not viewed as an "applicable or relevant and appropriate requirement", or

ARAR, at the time of risk assessment compilation, literature cited by WDNR indicated that a level of 3 mg/kg of CPAHs in sediment might constitute a "to be considered" value of what would constitute acceptable long-term aquatic habitat protection.

IV. Remedial Actions

Remedy Selection

The FS was completed in May 1990. Pursuant to Section 117 of CERCLA, U.S. EPA published a notice of completion of the FS and also released to the public a proposed plan for remedial action. After evaluation of public comment, U.S. EPA selected a remedy for the site as embodied in the Record of Decision (ROD) signed on September 27, 1990. The remedy consisted of components to deal with contaminated site soils, Little Menomonee River sediments, and site groundwater. Remedy components included:

- Particularly highly contaminated site soils were to be excavated, and to undergo treatment in a bioslurry vessel.

- Successfully treated soils and lower contaminated soils could then be disposed of under an appropriate cover, and the areas revegetated.

- Sediments were to be addressed by creating a new channel in the vicinity of the Little Menomonee River, removing the most highly contaminated sediments from the existing channel, and then diverting flow into the new channel, and filling the dewatered existing channel with soils created from new channel excavation.

- Contaminated site groundwater was to undergo collection and treatment, presumably using some manner of biological treatment system.

Remedial goals were to have risks posed by CPAHs in soils fall back below the 10^{-4} level, with a calculated value of approximately 6.1 mg/kg CPAHs being within the acceptable treatability variance. For sediments, the new channel would help ensure exposure to below the 3 mg/kg "to be considered" sediment quality criterion for acceptable long-term exposure to CPAHs in the aquatic habitat. Removing the worst of the contaminated sediments in the existing channel, calculated at a value of 388 mg/kg of CPAHs or higher, would help minimize migration potential from the old channel to the new. Groundwater remediation goals were to prevent undue migration of contaminated site groundwater into the Little Menomonee River, and to attain concentrations as denoted in ch. NR 140 of the Wisconsin Administrative Code concerning key contaminants of concern at the site. Key groundwater contaminants were viewed as PAHs and BTEX compounds.

Preremedial Design Measures/Pilot Tests/Administrative Reforms

Following ROD development, U.S. EPA entered into discussions with potentially responsible parties. On December 30, 1991, the United States lodged a consent decree with the Federal District Court for the Eastern District of Wisconsin in Milwaukee. This Consent Decree, which was signed by U.S. EPA, the State of Wisconsin and KMC, required KMC to implement the Remedial Design and Remedial Action set forth in the ROD. (The County of Milwaukee and the Union Pacific Railroad (formerly known as the Chicago and Northwestern Railroad) submitted comments on the Consent Decree. The County of Milwaukee filed objections to the Consent Decree and sought to intervene in the proceeding in 1992. U.S. EPA responded to the comments and objections in its 1993 Motion to Enter. The County withdrew its objections in February 1996, after reaching an agreement with U.S. EPA on past costs. The decree was entered by the Court in March 1996).

While the ROD viewed the site as one overall operable unit, there were several work components; and the Statement of Work which was a part of the RD/RA Consent Decree called for development of at least 20 predesign tasks, including certain pilot tests, to advance site knowledge in key areas. Among other things, these areas included such items as investigating analytical procedures to check for CPAHs on a lower cost, rapid turn-around basis, refining background quantification levels of CPAHs in site soils and sediments, evaluating alternative river alignments, studying river floodplain hydraulics, using visual criteria in identifying creosote in sediment residues, evaluating dredging techniques, and pilot testing soil washing and bioslurry treatment and techniques.

While the partial list of predesign tasks and pilot test areas discussed above relates to technical and engineering refinements that may guide remedial development, U.S. EPA is also aware of various administrative and guidance reforms which might affect site cleanup. As the site specific predesign work got under way in 1994, opportunity also arose to incorporate such reform suggestions as making site cleanup consistent with more realistic site user patterns. As will be explained further below, in the case of the Moss-American site, this meant exploring soil cleanup numbers based on industrial land use patterns which were reflected in the institutional controls and executing those institutional controls necessary to justify such change.

Another common sense program reform expectation is that remedial cleanup will attempt to deal with "worst first" situations. Hence, as results began to emerge from the various predesign and pilot study tasks, and taking these into account along with administrative reform efforts and a desire to deal with the most pressing site problems first, certain "staging" of work phases occurred. Administrative as well as technical developments justified the 1997 Explanation of Significant Difference, and a 1998 ROD Amendment. These will be discussed later in this review.

"Worst First" - Free Product Extraction Measures

Based on the November 1994 predesign results, U.S. EPA issued correspondence to KMC asking them to give initial priority to removing the free product. The predesign report indicated that free product materials in extractable quantities were concentrated in an area of approximately one acre south of Brown Deer Road and west of the Little Menomonee River. In 1995, KMC undertook design, construction and installation of a removal system featuring extraction wells, conductivity probes to distinguish between creosote and groundwater, and supplementary storage tanks.

The free product was mostly concentrated at a depth of 6 to 12 feet below the ground surface. The free product is composed primarily of a mixture of creosote and #6 fuel oil, which was used during past site operations. This mixture has a greater specific gravity than water, and due to its relatively insoluble nature would constitute a dense non-aqueous phase liquid, or DNAPL. DNAPLs tend to complicate and prolong groundwater remediation efforts.

There were three main components of the free product recovery system. These were: 1) the recovery well network, 2) the piping/storage tanks, and 3) necessary instrumentation, such as conductivity meters and gauges. KMC installed six recovery wells. Each well was equipped with an individual pump capable of generating a maximum flow of 8 gallons per minute. Well boreholes went 13-16' below the ground surface. Wells were screened at the bottom with 5' screens. Piping consisted of a 1" inner pipe inside a 2" outer pipe. Materials collected were conveyed to the first of two 10,000 gallon steel tanks. The first tank received a combination of free product and groundwater. As water separated from the mixture, it was decanted to the second 10,000 gallon tank.

The system utilized the notable difference in conductivity between petroleum based free product and water. Each well was linked to a conductivity probe. When the probe detected an increase in conductivity, indicating that the liquid in the well was changing from mostly free product to mostly water, pumping would cease. KMC sent collected materials to Rhodia, Inc., a disposal facility in Indiana.

The following list describes the quantity of liquids recovered during the primary years of operation of the free product recovery system:

1996 - 3100 gallons
1997 - 7500 gallons
1998 - 1080 gallons
1999 - 900 gallons

KMC estimates that on average 10% of the extracted liquids were creosote, and 90% were contaminated groundwater.

Extraction wells installed for free product recovery were designated as part of the "PW" series. Some temporary groundwater monitoring wells were also installed, and were designated as "TW". During 1997, KMC observed that wells PW - 5 and PW - 6 were not yielding creosote. To improve recovery, pumps from wells PW - 5/6 were removed and installed into wells TW-6/7. This did not significantly improve yield, such that over the life of the free product recovery system wells PW - 1 through 4 collected the overwhelming volume of material.

In terms of lessons learned, a schedule of intermittent pumping was found to be more productive than continuous operation. Also, peristaltic pumps seemed best suited for the task. KMC estimates that capital cost for construction of the free product recovery system at $ 250,000. Including disposal fees, operation and maintenance costs averaged approximately $ 20,000 per year over the four year life of the system.

In the fall of 1999, the free product recovery system was dismantled, as construction of the funnel and gate groundwater collection and treatment system began.

Explanation of Significant Difference

In April 1997, U.S. EPA signed, with WDNR concurrence, an Explanation of Significant Difference (ESD) concerning site contaminated groundwater collection and treatment.

Predesign results indicated that compared to the means of groundwater management as originally described in the ROD, a funnel and gate system may offer certain advantages. While exhibiting certain heterogeneity, soils at the Moss-American site generally tend to be relatively fine-grained. This condition tends to lead to relatively slow groundwater movement. Hence, there would appear to be adequate time for contaminant treatment as water is directed through a given gate. Design information indicates that once optimum nutrient/air dosages are established, groundwater contaminants such as those that occur at the Moss-American site may undergo effective aerobic degradation.

Basically, a funnel and gate system would redirect groundwater flow by using sheet piling driven into a silty clay till confining soil layer underneath the contaminated aquifer. Sections of piling would be interconnected and sealed. Engineered soil media (gates) would be introduced so as to preferentially direct groundwater flow. Treatment would be accomplished by introducing air and nutrients in-situ in the zones of preferential groundwater flow so as to bring about the biological reduction of BTEX and PAH compounds in the groundwater.

Design envisioned two parallel lines of funnel and gate systems in operation. The western most line would be placed near the boundary line between Railroad and County property. Another line would run roughly parallel to the Little Menomonee River, just west of the river. An effective monitoring scheme consisting of several groundwater wells is an essential part of the system as well.

During the course of the pilot work, the funnel and gate system would attempt to develop those conditions of oxygen and nutrient addition necessary to bring about optimum performance. One gate would be operated as a "control" gate to serve as a baseline comparison to the active treatment gates. No oxygen enhancement or nutrient addition would occur at the control gate. A second gate would be subdivided into two smaller "active" gates where varying dosages of oxygen and nutrients would occur for comparison and system optimization.

Velocity of groundwater flow through the gates should be low enough so as to allow for sufficient treatment. In order to help prevent free-product migration into the treatment gates, engineered sumps on the upgradient side of the gate were installed.

A system of upgradient, in-gate, side gradient and downgradient monitoring wells was installed for performance monitoring purposes. Parameters to undergo periodic evaluation include, but are not necessarily limited to, such constituents as oxygen-demanding substances, BTEX compounds, and PAHs.

ROD Amendment

Specifically for this site, the 1990 ROD envisioned soils treatment using bioslurry technology. Pilot testing done by KMC/Weston indicated reasonably good soils treatment of the lighter 2-3 linked hexagonal ring sized fractions of the PAH contaminants in soil using bioslurry technology, but a decided dropoff in treatment efficiency for the 4-6 ring PAH compounds. Since the leading site soil contaminants of concern were the heavier PAH compounds with carcinogenic properties, after consulting the literature and RODs for other creosote sites, U.S. EPA in 1998 developed a ROD amendment which authorized a soils technology change to thermal desorption.

In September 1998, U.S. EPA issued a ROD Amendment which dealt primarily with site soils. WDNR conditionally concurred with this amendment. The ROD Amendment provided for use of thermal desorption as a treatment technology to deal with more highly contaminated site soils. EPA now considers thermal desorption a presumptive remedy for wood preservative treatment sites. The ROD Amendment also incorporated more recently developed State cleanup standards for soil related contaminants. In addition, it allowed for non-residential direct contact cleanup exposure scenarios if appropriate deed restrictions were secured. The ROD Amendment withdrew a waiver of State liner/leachate provisions, but provided for a Corrective Action Management Unit (CAMU). Based on review of groundwater monitoring network analyses and related soils data, the ROD Amendment also added some contaminants of concern, such as naphthalene.

The 1998 ROD amendment allowed for containing soils on the wood preserving plant property such that capping over areas resulting in direct contact exposure to total carcinogenic PAHs of levels higher than the residential exposure scenario of 1.9 mg/kg was possible, provided that deed restrictions to industrial or recreational exposure levels were obtained by KMC from the affected site property owner. In this case, the property owners in question are the Union Pacific

Railroad, and Milwaukee County. Such action was in keeping with more realistic land usage reforms as suggested by U.S. EPA. In July 2000, these property owners provided U.S. EPA with copies of deed restrictions submitted for recording that allow for recognition of land usage other than residential on the Union Pacific property and on County property at the wood preservation plant. Hence, the industrial and recreational exposure scenarios for cleanup of 3.1 mg/kg and 15 mg/kg, respectively, of total carcinogenic CPAH levels may be allowed for certain site areas if these use conditions are imposed in the deed restrictions. U.S. EPA will need to further evaluate the effectiveness of the documents recorded, to continue to rely on this institutional control. U.S. EPA will base future soil containment design reviews on the premise that cleanup to other than residential exposure scenario is acceptable.

By the time of the 1998 ROD amendment, the introduction of NR 700 as a part of residual management added further dimension to remediation. NR 700 recognized that cleanup should consider not only the direct contact pathway, but also provide sufficient protection such that remaining contaminants do not pose an undue threat as a source of groundwater contamination. Concentrating on soil treatment methodology and pertinent residual contaminant levels (RCLs) for former site production areas, the ROD amendment provided groundwater protection component RCLs for parameters where attainment of preventive action limits was not being realized, as well as direct contact values permissible under residential or industrial site usage exposure scenarios. Groundwater protection component RCLs were provided for naphthalene, fluorene, benzo(a)pyrene, toluene, xylene(s), ethylbenzene, and benzene. The 1998 ROD amendment also considered floodplain portions that might be affected by soil remediation technology, as well as possible recreational usage of portions of the site.

Remedial Design

With efforts under way to attempt to manage collection of free product creosote materials, attention turned to contaminated site groundwater and soils. Contaminated groundwater and soils were addressed before sediments because unchecked groundwater and contaminated soils have the potential to recontaminate river sediments.

Groundwater Management System Design

In 1997, U.S. EPA issued, and WDNR concurred with, an Explanation of Significant Differences (ESD) which would allow KMC to utilize an in-situ form of groundwater treatment known as a funnel and gate system. This system involves placing more porous soils to preferentially direct groundwater flow, and introducing air/oxygen, microbes, and nutrients if necessary so as to enhance biological degradation of organic contaminants within groundwater. The polycyclic aromatic hydrocarbon (PAH) content of the groundwater appears to consist of mostly 2-3 ring PAH compounds, which may be successfully treated by a biological approach. In contrast, the more complex 4-6 ring PAH compounds are more strongly associated with site soil. Such heavier compounds tend to resist biological attack. The funnel and gate concept is considered innovative.

The Design calls for three tiers of two gates each where treatment will occur. Should results indicate that supplementary groundwater control measures may be necessary, U.S. EPA will require KMC to conduct further action. The funnel and gate system and in-situ treatment may provide an operation and maintenance cost advantage compared to other more conventional approaches. Given that the presence of residuals of free-product creosote may lengthen the time needed to accomplish groundwater management goals, which remain unchanged from the 1990 ROD, U.S. EPA believes it is appropriate to allow an innovative approach in this circumstance. In 1998, KMC finalized the design for the groundwater collection/treatment portions of the cleanup project, and the agencies indicated design approval subject to certain conditions. In November 1998, a small portion of the groundwater system remediation got underway with the construction of a pad to be used for temporary storage of some of the more contaminated soils that would require excavation during construction of the groundwater treatment system.

Site Soils Treatment Design

Soils Treatment - As discussed in the 1998 ROD amendment, the most highly contaminated soils at the Moss-American site are to undergo treatment utilizing thermal desorption. Initial design documents were received for review in 1999. After several iterations, the agencies conditionally approved the final design package in Spring 2000. During June 2000, KMC and their design firm solicited bids to perform needed thermal desorption work. Severe winter weather conditions plus propane shortages postponed set up of thermal desorption equipment for several weeks, until spring 2001.

Soils subjected to thermal desorption treatment include all soils that:
- contain free product
- exceed a total carcinogenic polynuclear aromatic hydrocarbon level of 78 mg/kg
- exceed groundwater residual contaminant levels (RCL) of 2.9 mg/kg for ethylbenzene; 1.5 mg/kg for toluene; 4.1 mg/kg for xylene(s); 5.5 ug/kg for benzene; 48 mg/kg for benzo(a)pyrene; and 100 mg/kg for fluorene
- exceed 100 mg/kg for naphthalene

(Note - in this instance, the groundwater RCL for naphthalene is 0.4 mg/kg. However, KMC was able to demonstrate to the agencies that over 96% of the naphthalene loading in site soils was associated with areas having over 100 mg/kg of naphthalene. Hence, provided that the agencies can see that future groundwater monitoring shows a favorable trend in naphthalene levels, the agencies will accept pick up and treatment of naphthalene at the 100 mg/kg contour line. Once subjected to treatment, soils thus treated must attain 0.4 mg/kg naphthalene. Should subsequent groundwater monitoring not indicate a favorable improvement in naphthalene levels in groundwater, the agencies reserve the right to require stricter naphthalene contaminated soil cleanup.)

Design documentation indicated that a range of soil volume of from 42,000 to 66,000 tons of contaminated soils may undergo thermal desorption treatment. In practice, however, this

quantity of soil actually treated more than doubled. Thermal desorption work was conducted from April 2001 to February 2002. KMC and its consultant took further soil samples from excavated areas, and found quite often that additional soils required further excavation and treatment. In all, some 137,000 tons of contaminated soils were treated.

Sediments Management Design

Initially, for the project as a whole, the parties to the RD/RA Consent Decree envisioned three construction seasons running from late summer to late winter. The reason for such choice of time period is that (on the average) stream flows are down in late summer and fall compared to spring, and in winter - barring extreme weather conditions - construction work along a stream can leave less of a "footprint" when the ground is frozen. There are five stream "segments" along the Little Menomonee River from the former creosote operations facility to the confluence with the Menomonee River. A "segment" is roughly defined as that interval of stream between major highway bridge crossings. There are five such bridge crossings along the site course of the Little Menomonee River. Each "segment" is about 6000-7000' in length. Segment 1 would be addressed during the first design/construction season. Segments 2/3 would be addressed during the second design/construction period, etc. Rather than develop one overall sedimentation design package, a package would be developed on a segment-by-segment basis. This allows us to apply lessons learn from the construction of earlier segments in the design of later segments.

The main design concepts which guided Segment 1 (from Brown Deer Road to Bradley Road) were:

Creation of new river channel from near Brown Deer Road downstream to approximately the Wisconsin and Southern Railroad bridge, subsegment by subsegment dewatering and fill in of existing river channel in that length, and dredging to meet cleanup objectives and continued use of the present stream channel from the Wisconsin and Southern Railroad bridge to Bradley Road.

Site Preparation - including tree clearing as needed, creation of gravel haul roads, usage of silt fencing for erosion control, etc.

Access/Security Arrangements - These arrangements included installing a gate with points of entry to haul roads and channel excavation areas for public safety and security, and usage of temporary asphalt sections to connect gravel haul roads and public streets so as to minimize soil carryover onto such streets.

Topsoil Removal and Storage - Clean topsoils are stockpiled for later use in revegetation efforts.

Excavation of New River Channel - To be conducted in two phases, centering around an important crossover point of old/new channel. The new channel bed will try to incorporate pools, riffle areas, and minor sinuosity increases as in-stream enhancements.

New Channel Cross-sectional sizing - Average width and depth was guided largely by application of the standard U.S. Army Corps of Engineers "Hydrologic Engineering Center" HEC-2 Program for water-surface computations. The standard HEC-2 program underwent certain modifications, based on application of local conditions, and subject to site-specific constraints and information. For example, the local soils within Reach 1 are largely inorganic clays, inorganic silts, or some combination of both. Channel slope was calculated for both the existing and projected new river segment in segment 1. It is a desirable environmental feature to increase stream sinuosity. However, from Brown Deer Road to Bradley Road there is only a 2' drop in stream bed elevation. Therefore, one could not have an "infinite" increase in sinuosity without an adverse effect on the stream being able to flow and carry certain silt loads along with it. Calculations indicated that an increase of about 1% in overall sinuosity, while decreasing channel slope by about 1% as well, would not have an overall negative effect on channel stability. Minor channel meanders were incorporated into design with the thought of avoiding important existing features and yet giving the new channel sections a more natural aesthetic appearance.

It was also important to ensure that the new channel was running through an area of low PAH content; hence the proposed stream route was sampled first to check that this condition was met.

Dewatering of Existing Stream - Constructing crossings between old and new channel and dredged portion between the Wisconsin and Southern RR bridge and Bradley Road using methods such as inflatable dams or other appropriate devices to block stream flow and temporary pumps and piping to bypass this section while allowing it to drain.

Pumping capacity for existing stream flow - Have available 3 - 8000 gpm pumps putting water into high density polyethylene piping. 90% of the time, the flow in the LMR should be 16,000 gpm or less. Work would need to cease during significant storm events. In a section being dewatered, there would be a smaller 100 gpm pump to take "quiet" dewatered areas and containerize this for further treatment, since such "dregs" may have been more likely to contact old creosote deposits.

Miscellaneous debris - tires, etc. Management depends on if the debris were biodegradable or nonbiodegradable. For example, tree deadfalls could be mulched and recycled; tires/metallic objects would be hauled off site.

Perform dredging so as to remove all sediments with CPAH content > 15 mg/kg in stream from Wisconsin Central Railroad bridge to Bradley Road.

Allow diversion into new channel. Vegetate with native plant species. Check survival rate of new plantings for a period of several years thereafter to ensure desirable percentage of native stock species survive, to help both habitat enhancement and erosion minimization.

Old channel work - Fill old channel with clean non-topsoil materials from new channel excavation. Cover with topsoil and revegetate. Once dewatered, remove all "visible contamination" and CPAH deposits greater than 388 mg/kg. Send such contaminated materials to stockpiles to hold for subsequent dewatering and waste management.

Mapping site wetlands - Delineating site wetlands was also part of design work, since any wetlands lost in one area had to be replaced on a one-to-one basis elsewhere on site under the RD/RA CD. Furthermore, if at all possible, new channel location would try to minimize impact on existing higher quality site wetlands.

Design must give consideration to places where culverts or storm sewers enter the current stream channel. Depending on their direction of origin, and relative location compared to new channel reaches, such culverts would need to be either cut off or lengthened. Any extension was done via open channel flow, since such flow is more conducive to creation of sedimentation devices in the new stream, such as pools, that help prevent scour and help buffer impact of high flow discharges that could lead to bank stability problems.

Monitor groundwater between old and new channel sections to detect whether undesirable degree of residual migration occurs.

In moving on to Segment 2/3 design, following Segment 1 construction, primary "lessons learned" and opportunity for improvement included:

A recognition that tree canopy is important not only for aesthetic reasons, but also that such shading helps minimize water warming effects in summer weather, and helps reduce unwanted algae growths. In conducting Segment 2 and 3 work, one difference in tree replanting is to make it less "linearly proportional". Rather than replant a set number of trees per acre, work may feature creation of tree planting "clusters", designed to accomplish the greatest good at a given key location.

Stabilization steps will deal with the question of invasive species. Use of localized herbicide applications will try to control growth of such invasive species as reed canary grass, garlic mustard grass, buckthorn, box elder, etc., to help give plantings of native grasses, shrubs, and trees a better chance for survival.

There will be far less chipping of trees that had to come down. State and private consultant habitat specialists believe that using tree root balls, as one example, can be a useful tool in helping to create desirable aquatic habitat, and yet still not interfere with stream flow patterns. Any trees that are taken down, and are selected for reuse within the new river corridor to help create desirable aquatic habitat will be anchored down, such that they neither interfere with river flow nor are carried along to locations where they might form localized dams.

The work will be done in such manner as to try to have less of a "footprint" on its surroundings. Rather than create an entirely new haul roads to help facilitate new channel construction, excavation of new channel sections will help create "one-pass" haul roads. While some tree loss will be unavoidable, such a means of construction will help reduce the number of trees taken down compared to Segment 1. Construction in Segments 2 and 3 will also try to minimize any damage to nearby hiking/biking trails - such trails were not present in Segment 1.

The habitat features of Segments 2/3 influenced the selection of the new channel location to a greater degree than the features of Segment 1. Segment 2 and 3 features included the presence of high quality existing wetlands. The goal was to route the new channel through lower value wetland areas. Moreover, the Consent Decree mandated that there be no net loss of wetland acreage at the site. Within Segment 1, factoring in lands occupied by the funnel and gate groundwater treatment system, there was a loss of two acres of wetlands. Within Segment 2, there is opportunity to make up this difference with the creation of two (net) acres of wetlands. However, there will be some tree canopy loss as a result.

In addition, Segments 2/3 contain more potential habitat areas for the Butler's Garter Snake, a snake on the State of Wisconsin's Threatened Species List, than Segment 1. Avoiding such areas where possible has therefore been a factor in new channel location selection. Before work commenced on Segment 2/3, WDNR posted a public notice concerning possible incidental taking of a state endangered or threatened species, in this case the Butler's garter snake. This posting, in March 2004, described the threat posed to the snake by site construction work, what mitigating steps (such as capture fencing) were being taken to minimize snake loss, and why conducting the work helped alleviate an overall contamination problem posed to the public. No adverse comments were received from the public concerning the continuation of site cleanup measures.

In reviewing the design, the agencies also considered soil crowns and dredge berms. Soil "crowns" that are created when filling in portions of the existing channel which are to be abandoned. The "crown" elevation upon filling in former channel segments should be viewed as a temporary feature that will disappear with settling.

Additionally, the work on Segment 1 removed dredge berms left by historic stream channelization projects. Their removal enhanced the stream's connectivity with its floodplain, increasing the value and function of its wetlands, and reducing the potential damages to floodlands from avulsion. The design for Segments 2/3 sought to include additional opportunity to enhance floodplain connectivity via partial removal of historical dredge berms.

Remedy Implementation - Construction Activities

Groundwater Remediation Phase

Quality assurance documents for the groundwater system installation were finalized in 1999. In

November 1999, field construction began. Primary installation steps included:

- Installing temporary structural sheet piling
- Excavating treatment gate areas
- Dismantling wells/piping associated with the free product recovery system
- Staging of more highly contaminated excavated soils in Staging Area #1; such soils are to undergo thermal desorption treatment along with certain other designated site soil areas. Less contaminated soils, which exceed naphthalene RCLs but not necessarily CPAH RCLs and are not contaminated with free product materials were put into Staging Area #2. (Pilot level evaluation of treatment of Staging Area #2 soils through biodegradation/landfarming is underway.)
- Preparing a blend of clean sand and other clean soils for gate backfill
- Collecting contaminated runoff with oil/water separation pretreatment followed by on-site sanitary sewer discharge or off-site hauling and disposal as necessary
- Grading gate areas after backfill
- Replacing temporary sheet piling with permanent Waterloo sheet piling
- Grouting the joints of the Waterloo sheet piling
- Pouring a concrete slab as a foundation for treatment building that was assembled on site.
- Drilling new injection wells for introduction of nutrient, air/oxygen, and/or microbe sources into the gate areas to enhance groundwater contaminant degradation.
- Drilling new monitoring wells to help determine gate performance and supplement existing monitoring wells to judge aquifer response in attaining goals
- Installing piping runs to convey nutrients from the treatment building to the individual gates.

KMC completed most of the construction phase in April 2000. However, the last three tasks noted above were delayed due to wet site conditions. U.S. EPA, in consultation with WDNR, sent KMC recommendations and suggestions on field techniques that could be employed to overcome this problem. KMC resumed construction in late May 2000. They completed injection/monitoring well installation first. Piping runs were then completed. By July 26, 2000, all regrading had been completed. Final inspection of the electrical connections was made by the City of Milwaukee, and all needed decontamination measures associated with groundwater system construction had occurred. Work was conducted to develop dosage rates of nutrients/air needed for optimal performance.

Soils Treatment Phase

Severe winter weather and blizzard conditions and the availability of propane, delayed the delivery and assembly of the LTTD component. The situation abated such that by February 2001 the construction kickoff conference was held.

The purpose of thermal desorption is not to actually "burn" the contaminated soils, but to heat them above the boiling points of the contaminants so that these are driven off the soil particles. Both soil particulate matter and the contaminants driven off require different forms of emission control. Particulate emissions could be generated if not controlled. At the Moss site, particulates

were captured by baghouses. A fabric filter catches particulates from the air stream going through the unit. At Moss, the system was run intermittently in May and early June to help the vendor get a better idea of optimum running conditions. Prior to start-up of full-scale operations, the vendor of the thermal desorption equipment replaced all the baghouse filters. The contaminants driven off the soils are in gaseous form, and require a flare to burn them off so as to avoid release into the atmosphere. The flare is to operate at a reduction efficiency of 99.99%.

After component assembly and initial runs, one of the minor contaminants associated with site soils, benzene, initially proved difficult in attaining treatment goals. Some experimentation was needed on both sampling and LTTD treatment run conditions on getting optimal temperatures and unit residence time so as to get best treatment. This optimizing took place largely in June 2001.

During the course of operations, the plant was inspected twice by air contaminant control personnel representing both the Milwaukee Health Department and the Wisconsin Department of Natural Resources. Improvements suggested by these entities and U.S. EPA were incorporated, including gathering more air data from the site perimeter, and lightly wetting down piles of treated soils temporarily staged pending analytical results.

In response to a letter received from a nearby business during the course of thermal desorption operations, U.S. EPA supplied copies of monitoring data. In examining these data, during October 2001 operations, there was only one temporary excursion of a desired volatile organic compounds (VOCs) level. This occurred during the 2:15 a.m. sample collection on October 5. By the 2:30 sampling event, the VOC level had dropped to a nondetectable level. All other values indicate no exceedance of desired levels for either VOCs or particulate matter.

During the course of LTTD work, lime was mixed in with soils to undergo thermal treatment for one of two main reasons: it helped absorb excess water in the soil, and it aided in trying to minimize/neutralize any generation of sulfur oxide compounds for some site soils where sulfur content of the soils was higher. With the exception of one delivery, when pelletized lime was unavailable, site operators used pelletized lime to help reduce dust generation when mixing lime and soils. When the pelletized lime was unavailable, thermal desorption unit operators were instructed to minimize any shaking of the bags of lime as well as the height from which they are emptied to reduce the potential for dust generation.

Prior to the commencement of thermal desorption treatment, U.S. EPA and WDNR approved a work plan for a pilot test to determine if soils which have been picked up, but contain predominantly naphthalene and little of the heavier PAHs, might be candidates for treatment through biodegradation/landfarming to attain the naphthalene groundwater RCL. While some positive pilot results were indicated for landfarming as a "niche" treatment method, it was decided that these soils could be put through the LTTD system more efficiently than in starting a new "learning curve" with landfarming. Hence, the pilot scale biodegradation/landfarming test was never scaled up.

Other details concerning thermal desorption operations may be found in the LTTD Summary Report as compiled by CH2MHILL in (late winter-early spring) 2002. This report is also included in reference listings. Once successfully treated, soils were at first returned to their place of excavation. However, the volume of the treated - and now uncompacted soil - exceeded original volume. Hence, other treated soils were at first stockpiled. Some of these were later graded in place. Other treated soils were used in old channel fill work.

Sediment Management

Field oversight of sediment management activity at the Moss-American site involves review of: dredging in localized areas, creation of new stream channel through relatively clean soil areas, diversion of current stream flow into the new channel areas, dewatering of "old" channel portions, removal of most seriously degraded "old" sediments, and fill of "old" channel segments with clean cuttings from "new" channel excavation.

A construction kickoff meeting was held on 9/4/02. Following field trailer utility hookup activity, construction began in earnest the week of September 9, 2002.

Primary activity during October and November 2002 was the excavation and creation of a new stream channel, in a routing near the existing stream but going through soil essentially free of the PAH-creosote related hazardous substances that contaminated the previously existing stream channel. In December 2002 and January 2003, the existing channel was dewatered section by section. Before soils excavated in creating the new channel were used as fill material in the old channel, sediments were examined for signs of most severe contamination. Such severe contamination was evidenced by "free-product" creosote, or "visible contamination". Correlation with approximate contaminant range is given in later discussion. Sediments possessing these characteristics were then excavated, and placed on a bermed concrete storage pad. About 10,000 cubic yards of such "visibly contaminated" sediments, believed to be the most obvious sources that could attempt to migrate into the new channel if not picked up and isolated, were removed. The new channel has slightly greater sinuosity than the former channel. Since reroute into a new channel is not feasible near road or railroad bridges, about the last hundred yards of the stream north of Bradley Road was not rerouted. Instead, since both a railroad and road bridge are in close proximity, the last 100 yards was dredged so as to maintain the existing stream channel, and achieve a sediment cleanup goal of no more than 15 ppm total PAH in stream sediments in this 100 yard stream stretch.

In the conduct of Segment 1 sediment remediation work, there were a couple of incidents that fell into the "lessons learned" category. These events were: 1.) The need to go back and do more excavation, once initial excavation for the new channel had taken place. KMC's construction contractor was using some very sophisticated monitoring equipment as excavation proceeded. A "global positioning device" was hooked up to the blade of the bulldozer doing the excavation such that the operator would know within +/- a centimeter if the cross-section being excavated

met design dimensions. But when survey measurements were taken after the initial excavation was made, the volume of the new channel was too low. The problem turned out to be that the computer program governing stream cross-section had not accounted for the stream thalweg, the deepest "mid-channel" part of the stream bed. Checking the cross-sections one by one, would have revealed this problem sooner. As such, some reworking of excavated areas was needed to go back and do further excavation to account for the thalweg. 2.) Part of the test of "visible contamination" - if free-product creosote is not immediately obvious - is to scoop up some questionable material and place it in a bucket of water to see if free, individual black or brown droplets are released. However, in winter weather conditions, frozen water can make it difficult to either collect a sample, or work with it. Subsequently, there were some cases in which the construction contractor made a conscious decision to leave a little water behind in dewatering a stream segment, to try to make it easier to see if droplets might form in the water.

Sediment remediation work involving Segments 2 and 3 was performed in two phases. Phase 1 work was performed from March 1, 2004 to July 16, 2004. Phase 1 work primarily involved preparation and construction of new channel areas. Other associated supplemental activities included installation of erosion control and snake barriers, clearing and grubbing for haul roads, transporting and disposing of previously stockpiled sediment materials from the Moss-American site to the Peoria Disposal facility in Peoria, Illinois, excavation of new channel, placement of woody debris, performing site maintenance to repair damage caused by high water/excessive rain, dewatering newly constructed channel, and stabilizing new channel lengths.

After new channel construction needed for Segments 2 and 3 was largely completed, there was a lull in heavy-construction tasks as new channel stabilization steps proceeded. During this time, in August 2004 KMC consultants performed surveys in Segments 2 and 3 to more clearly update and delineate where zones of "visibly contaminated" sediments were in "old" channel zones where dewatering and fill-in were necessary.

Phase 2 activities then began on September 13, 2004, and continued in Segments 2 and 3 until December 30, 2004. Phase 2 activities focused on those tasks that featured rerouting flow to newly created channel lengths, and in abandoning and filling in "old" channel sections. More specific Phase 2 activities included dewatering sections of channel to be abandoned, diverting flow from existing channel to new channel lengths, removing more highly contaminated sediments from portions of old channel to be filled in, backfilling and grading such portions of former channel, performing needed haul road maintenance, upgrading and repairing snake fence as needed, transporting further sediments from the Moss-American site to the Peoria Disposal facility, placing mats of seeding and mulching materials on new bank areas, removing some woody debris, anchoring tree sections/root balls into place so as to promote aquatic habitat, installing groundwater monitoring wells between old and new Segment 2 and 3 channel sections, and removing haul roads and reseeding areas as haul road lengths were no longer needed in areas where work had been completed.

As Segment 2 and 3 remediation work proceeded, about 9000 feet of new channel length was created. Some 8060 feet of previous river channel was eventually filled in. Some 2515 feet of river channel underwent dredging instead of rerouting to meet sediment cleanup objectives. Compared to Segment 1 work, the volume of more highly contaminated sediments from Segments 2 and 3 requiring excavation and removal before old channel zones could be filled in seemed to drop. For Segment 1, over 16,000 cubic yards of sediments required excavation and haul away. For Segments 2 and 3, the combined figure was approximately 8563 cubic yards of more highly contaminated sediments requiring excavation and removal.

There were a couple of relatively minor work deviations from design as Segment 2 and 3 work proceeded. Of importance to both the Milwaukee County, as bridge owner, and to the recreational public users, is the bicycle bridge over a length of Segment 3. Engineers retained by KMC noted that the bicycle bridge foundation rested upon certain large stream boulders. Hence, to avoid foundation disturbance, sediments in the immediate vicinity of these foundations were not excavated to sediment cleanup criteria. Also, in the immediate vicinity of the Good Hope Road Bridge, less riprap was used than originally planned for erosion protection purposes since the concrete from the bridge itself providing an adequate amount of riprap-like erosion protection.

Institutional Controls

Institutional controls (ICs) are those non-engineered instruments, such as administrative and/or legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of a remedy by limiting land or resource use. Although it is U.S. EPA's expectation that treatment or engineering controls will be the primary mechanism in dealing with most of the threat posed by release of hazardous substances at a given site, ICs can play an important role in the function of a given remedy. ICs may be used when contamination is first discovered, and when remedies are ongoing and residual contamination remains at levels that do not allow for unrestricted land use and unlimited exposure, even though other cleanup measures may be operating. The National Contingency Plan (NCP) emphasizes that ICs are meant to supplement engineering controls, and that ICs will rarely be the sole remedy at a site.

For the Moss-American site, the RD/RA Consent Decree, the 1996 past cost consent decree entered into with the County of Milwaukee (the County), and the 1997 past cost consent decree entered with the Union Pacific Railroad Company (Union Pacific) all explicitly required specific institutional controls. Part of the former wood preserving plant property is owned by Union Pacific, and the remainder is owned by the County. The County also owns much of the land along the five-mile stretch of the Little Menomonee River that is being re-routed. The County and Union Pacific have both recorded institutional controls at the site. With respect to the former wood preserving plant property, the institutional controls were updated in 2000 to prohibit non-industrial uses under State law using State Deed Restriction and Notice forms.

U.S. EPA sent correspondence to KMC on March 21, 2005, seeking review from KMC of efforts made to implement the specific institutional controls as called for in the Consent Decree, plus

discuss what other institutional controls may be necessary to implement to help ensure that remedy goals are achieved. The March 21, 2005, letter also requested the parties develop a schedule and be prepared to modify current operation and maintenance plans/procedures to adapt those institutional controls needed to attain remedial performance standards. By letter dated August 19, 2005, KMC observed that the parties revisted the question of land use controls and properly executed revised and expanded proprietary controls in 2000, and that landownership at the site remains unchanged; and opined that the effective combination of the implemented remedy and the expanded proprietary controls provide the protectiveness and effectiveness that EPA requires.

Technical assessment of protectiveness of remedial measures is made elsewhere in this report. It may also appropriate to consider protectiveness from the standpoint of Institutional Control measures, as well as technical performance.

One of the remedy components at the Moss-American site, the groundwater funnel and gate treatment system, involves long-term operation of a groundwater collection/treatment system, with a goal of restoration of ground water to MCLs, and another goal of prevention of movement of contaminated groundwater into nearby surface water. Institutional Controls (ICs) are required by the CD to prohibit residential use and groundwater use on a portion of the site and to prohibit interference with the work and damage to remedial action components. Review of recent groundwater monitoring results reports, and the site inspection indicate that groundwater contaminant levels remain above MCLs and Wisconsin PALs/Enforcement standards, and that no known current exposure exists.

U.S. EPA will review the ICs with WDNR and potentially responsible parties and other site property owners to determine whether the necessary restrictive covenants are adequate and are in place where needed.

U.S. EPA will review with WDNR whether Wisconsin has established a ground water protection zone covering the plume boundaries.

An IC plan will be developed to evaluate the effectiveness of groundwater restrictions. Considerations for this evaluation should include whether the IC "runs with the land," has been executed correctly and on all appropriate properties, provides adequate protection, may be negatively impacted by prior-in-time encumbrances, provides adequate notice to future owners, and will be monitored to ensure its continued existence. Further recommendations may be made based on the outcome of the evaluation.

U.S. EPA recommends contacting Wisconsin DNR to check on status of ground water protection zone and to evaluate/establish procedures for notification of EPA in the event of a breach.

At the Moss-American site, the soils treatment remedy component involves cleanup so as to allow for industrial use at the former wood preserving plant property, and ICs to prohibit residential use of that property.

Deed restrictions were recorded by the County and the Railroad previously on this matter. The IC Plan will also evaluate whether the deed restrictions implement effectively the land use restrictions needed. U.S. EPA will ask the potentially responsible parties and WDNR to review how the parties will manage any potential future changes in local zoning ordinances that could adversely affect site work already accomplished, or considered, which might undermine remedial or protectiveness goals.

Currently, the soils treatment component of the remedy appears from the standpoint of Institutional Controls to be functioning as intended by the decision documents, and initial exposure assumptions remain valid. It remains to be determined if the parties will be adequately informed as to possibly changing conditions.

With the local government, develop and implement a strategy regarding potential zoning changes and protectiveness issues. Establish procedures for notification of EPA and other pertinent parties in the event of a breach.

Operation and Maintenance Experience

Control Measures

The primary site activity which involves on-going O & M consideration is the running of the groundwater treatment system and building. On the question of "have such costs been trending unusually high", the reply was - not from a systems standpoint. There were a couple episodes of early part failure, in particular a bearing failure that caused blower outage. However, Weston/KMC attribute this to unfortunate experience with particular equipment items, rather than difficulty/added cost in running groundwater treatment measures as a whole. One important maintenance item to date is that the injected air may not have sufficient contact time with the aquifer in case dry soil conditions cause a "crack" allowing for a preferential escape pathway to the atmosphere, instead of preferred aquifer contact. (The groundwater table is relatively shallow; sometimes varying from a few feet to 9-12' bgs). Hence, small amounts of other site soils are occasionally needed to "patch" such minor soil fissures.

Groundwater-related items for which a frequent maintenance schedule is most needed consist of air filters for blowers, V-belts for motors, and blower motor mufflers for noise suppression. Minor oiling and lubrication is needed on a monthly basis. All such blower device maintenance is recorded in a log book. If no other activity other than lubrication is performed, the log book notation simply says "blower maintenance". If another item is needed - such as air filter, V-belt, noise muffler replacement, etc., a brief notation to this effect is noted. Weston keeps some parts within the treatment building; other routine items are available within one day. There is some capability within the system that if one blower motor is down, there can be some shifting via the electric panel so that on a temporary basis one of the remaining motors can do cross feed air injection into other air lines normally served by the motor which may be down for servicing.

Groundwater Remediation Results to Date -Interpretation/Discussion

Treatment /Remediation Issues - Very good contaminant removal efficiency is occurring at the more upgradient treatment gates within the groundwater funnel and gate treatment system. Typically, naphthalene concentrations drop from around 4000 ug/l to 40-80 ug/l to 8-10 ug/l as groundwater flows from the upgradient side of the gate, into the gate treatment zone itself, and past gates one and two. However, little beneficial treatment is occurring at the two more downgradient pairs of treatment gates. Both U.S. EPA and WDNR have noted this observation to KMC and Weston. KMC's consultant undertook the placement of about 10 additional piezometer wells in the vicinity of the various treatment gates to get a better idea of flow conditions. These wells indicate that groundwater flow is nearly stagnant at the downgradient pairs of treatment gates. The groundwater monitoring well network indicates that there is a pocket of contamination downgradient of the first pair of treatment gates (which are providing good treatment efficiency), and upgradient of the pairs of treatment gates where flow conditions are nearly stagnant.

If free product continues to be present near MW-34, one might create a small trench in the near vicinity to allow for collection and disposal. If the free product situation dissipates in the future, one could consider adding another gate area in this vicinity. While that might be an extra capital cost, it could be cost effective if the main problem is indeed there , and adequate subsequent demonstration might show that gates 3/4 and 5/6 only need to be run part time instead of full time.

Soil/Sediment Remediation Results to Date -Interpretation/Discussion

All soils that contained free product, had CPAH content > 78 ppm, exceeded groundwater RCLs for the BTEX compounds, exceeded RCLs for which WDNR had established RCLs for individual PAHs - (e.g. fluorene and benzo(a)pyrene) - except for naphthalene, which is a separate case as noted earlier - were excavated and treated. Verification in the field was made by testing excavation sidewalls and bottom. If analysis indicated exceedance of any of these values, further excavation was performed. Detailed information on levels that remain is not fully known. Soils excavated underwent low temperature thermal desorption, after first being screened for larger rock fragments in the soil which would not be compatible with the treatment unit. Such larger rock fractions were sent off-site to Peoria Disposal. Soils having undergone treatment were tested to see if they attained RCLs. Testing was done by both Weston representatives, and spot checked through split samples by CH2MHILL as U.S. EPA's oversight contractor. On average, about 20% of all batches needed to be run through the LTTD unit a second time. After a second treatment, the great majority of treated soils attained RCLs, including naphthalene. A few batches did not. However, after discussion of this issue with WDNR, if the violation stemmed from minor BTEX excess (which was the case) - these few batches were spread over ground at the funnel and gate groundwater treatment system. The reasoning was that if any substances leached out of the soils, they would be captured by a system compatible with their further treatment.

The great majority of sediments excavated from old channel areas or channel portions where existing channel is to be maintained have been sent offsite to Peoria Disposal facility, located in Illinois. No Corrective Action Management Unit (CAMU) unit has been constructed as yet, as KMC wants to see what is left after sediment management work is done, and handle all remaining items at one time. Some successfully treated soils have been used as fill in old channel areas to be filled in. The great majority of LTTD treated soils were put back and graded to original contours in their initial places of excavation. These soils attained industrial use scenario cleanup goals. However, soil volume is greater after treatment than before. Original excavations could not hold all the treated soil. Some was stockpiled near the former free-product recovery area. This stockpile has largely disappeared, as much of these treated soils have been used as needed fill in sediment management work involving former channel filling. A small portion remains. This could be placed in a CAMU unit, or KMC may propose to send it offsite.

Excavated sediments have been disposed at the Peoria Disposal facility in Illinois. Prior to shipment, the sediments are dewatered, in some cases by adding lime. Sediments awaiting the dewatering process and shipment are temporarily stored on an asphalt pad. CPAH levels which remain in the old channel have had all obvious traces of "visibly contaminated" materials removed prior to filling in the former channel section with clean soil. Predesign testing indicates that such residuals should be below 388 ppm CPAH - which was the 10^{-4} exposure level developed in the 1990 ROD. Attainment of this level does not allow Unlimited Use/Unrestricted Exposure of the former channel.

15 mg/kg CPAH represents a figure calculated by WDNR for different purposes: 1.) a recreational soil CPAH content considered safe for recreational site users, as well as an acceptable soil content to prevent undue future runoff to the new/existing stream; 2.) an average of site-specific, "to be considered" information developed in the pre-design stage by WDNR which reflects what should be attainable and sustainable CPAH levels in the Little Menomonee River, taking into account the urban nature of the setting; and 3.) aquatic habitat protection in an urban setting. The 15 mg/kg CPAH figure is neither an ARAR nor a background number. For the first three segments addressed thus far, the 15 mg/kg figure has been attained. Meeting this value does not provide for Unlimited Use/Unrestricted Exposure of the former channel.

V. Progress Since the Last Review

This is the second five year review report to be developed for the Moss-American site. Significant site developments over the past five years include achieving operational status of the funnel and gate groundwater collection and treatment system, performing remedial design development and remedial action which provided for the low temperature thermal desorption treatment of approximately 137,000 tons of more highly contaminated site soils, the filing of necessary deed instruments to recognize the industrial nature of significant portions of the site, and the remedial design development and remedial action of sediment management within three of the five affected Little Menomonee River stream segments.

VI. Five-Year Review Process

Administrative Components

On January 26, 2005, U.S. EPA sent a letter to WDNR and Kerr-McGee Chemical LLC informing them of the need to compile a second Five Year review Report for the Moss-American site. Mr. Thomas Wentland of WDNR served as principal state contact. For KMC, the principal contact was with Mr. A. Keith Watson, who in turn coordinated as necessary with both KMC technical consultants and KMC management representatives. Ms. Sue Pastor of Region 5's Community Involvement section arranged for public advertisement of the Five Year review effort. U.S. EPA supplemented its January 26, 2005, letter with a less formal outline sent April 14, 2005, not only to WDNR and KMC representatives, but also to the County and the Railroad. This communication further outlined goals and procedures of the Five Year review process, and requested cooperation of the various parties as the information-gathering process took place.

Community Notification and Involvement

On February 22, 2005, via advertisement placed in the "Milwaukee Journal Sentinel", U.S. EPA informed the community (see insert) that a Five-Year Review Report compilation effort had commenced for the Moss-American site. The notice issued described important efforts made at the site in Milwaukee, Wisconsin. Readers of the notice were given information as to location of local site information repositories, and were provided names, mailing addresses, toll-free and direct dial phone numbers, and e-mail addresses of both the Community Involvement Coordinator (CIC) and the Remedial Project Manager (RPM) for further information. The notice requested that interested persons relay any information of interest, comments, or site matters to either the CIC or the RPM.

Update of current Activities and Status:

(For further information and a pictorial history of recent site construction activity, the reader is encouraged to see the following website as maintained and updated by Region 5's Community Involvement Section. Some example photos follow this page).

http://www.epa.gov/Region5/sites/mossamerican/index.htm

Document Review

Much of the document review needed comes from analytical results of the groundwater monitoring network as maintained, sampled, and analyzed by technical representatives of the Responding PRP, Kerr-McGee Chemical LLC. A compilation of these groundwater analyses is

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Insertion Number:
Size: 2x6.5
Color Type: B&W

/2005
he ad appeared in the Milwaukee Journal Sentinel on the date and page ind

bracing for what they call a potential new threat this spring: the Minutemen.

Nearly 500 volunteers have already joined the Minuteman Project, anointing themselves civilian border patrol agents determined to stop the immigration flow that routinely and easily seeps past federal authorities. They plan to patrol a 40-mile stretch of the southeast Arizona border throughout April when the tide of immigrants crossing the U.S.-Mexico border peaks.

"I felt the only way to get something done was to do it yourself," said Jim Gilchrist, a retired accountant and decorated Vietnam War veteran who is helping recruit Minutemen across the country.

"We've been repeatedly accused of being people who are taking the law into our own hands," said Gilchrist, 55, of Aliso Viejo, Calif. "That is an outright bogus statement. We are going down there to assist law enforcement."

Officials concede that 370-mile Arizona border is the most porous stretch on the U.S.-Mexico line. Moreover, recent intelligence shows that al-Qaida terrorists are likely to enter the country through the Mexico border, James Loy, the deputy secretary of the Homeland Security Department, said last week.

Of the 1.1 million illegal immigrants caught by the U.S. Border Patrol last year, 51% ...

■ Percentage of illegal immigrants caught by U.S. Border Patrol in 2004 who crossed into Arizona

51%

■ Percentage of federal border agents who work in Arizona

24%

largest staff, from 1,700 to 2,100 over the last 18 months.

But that number is going to grow to try to plug the remaining holes, said Customs and Border Protection Commissioner Robert C. Bonner. About 10,000 federal agents now patrol the 2,000-mile southern border, he said.

Officials fear the Minuteman patrols could cause more trouble than they prevent. At least some of the volunteers plan to arm themselves during the 8-hour desert patrols. Many are untrained.

"Any time there are firearms and you're out in the middle of no man's land in difficult terrain, it's a dangerous setting," said Bonner, whose agency is keeping a close eye on the Minutemen plans.

"The Border Patrol does this every day, and they are qualified and very well-trained to handle the situation," he said. "Ordinary Americans are not. So there's a danger that not just illegal migrants might get hurt, but that American citizens ...

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included in this report. Other documents of interest are listed in the Reference section. These include recent decision documents, articles and literature pertaining to possible contaminant break-down products, guidance on developments related to contaminant of concern toxicity, media pathway refinement, possible means of degrading the contaminants of concern, operation and maintenance practices, etc.

Data Review

Groundwater data considered in this report were obtained from quarterly monitoring sampling/analytical efforts conducted by KMC consultants since the funnel and gate groundwater control system became functional in the summer of 2000. Groundwater bar graphs of a selection of significant site groundwater contaminants at key monitoring wells are presented herein. Possible action concerning a certain trend is discussed more fully in the "Issues" section. At this point, groundwater remains contaminated as it passes through the first gate area. Looked at over the 2002-2004 period, some monitoring wells are reflecting a slight downward trend in contaminant concentration. An exception to this are rising concentrations in the vicinity of monitoring well MW-34. What might be done about this situation is the focus of "Issues" discussion.

Site Inspection

U.S. EPA made arrangement with WDNR staff, KMC representatives and their consultants, as well as other major site land owners, to be present at a site inspection conducted on June 28, 2005. The inspection examined past creosote plant operating areas, as well as recently remediated stretches of the Little Menomonee River. Former plant operations inspection focused on operations at the funnel and gate groundwater treatment building, and associated air injection equipment and the groundwater monitoring well network. River locations visited examined current degree of success of river bank and (former) access road revegetation efforts, spots where it has been necessary to attempt the control of invasive plant species, and the field presence of desirable new channel features (riffle zones, pool areas) which sediment management remediation wished to incorporate.

Interviews

Interviews were conducted as part of the June 28, 2005 site inspection. Please note topics discussed as part of the inspection summary.

VII. Technical Assessment

- *Question A: Is the remedy functioning as intended by the decision documents?*

Thus far, the answer appears to be "yes". As discussed elsewhere in this document, with regard

Photo Archive 3 - Constructing New Treatment Building

Constructing the new ground water treatment building for the funnel and gate treatment system.

Click on a photo to view a larger image.

curing concrete in winter

constructing new treatment building

pouring floor of new treatment building

preparing sand/soil mixture

Photo Archive 6 - Soil Treatment (2001)

Treatment of most highly contaminated soils using thermal desorption (2001)

Click on a photo to view a larger image.

power screening unit

testing bioremediation technique

thermal desorption unit & treated soil pad

disassembled thermal desorption equipment

treated soil piles

Photo Archive 8 - Constructing the New Channel (2004)

Wood chipping in new channel area of Segment 3. (June 2004)

A surveyor checks the elevation of the new streambed during new channel excavation in Segment 3. (June 2004)

A hauler unloads excavated material from the new channel while a bulldozer pushes material to a transfer station in Segment 3. (June 2004)

An erosion control mat and woody debris have been placed in the new channel in Segment 3. (June 2004)

A backhoe removes woody debris near the new channel in Segment 3. (July 2004)

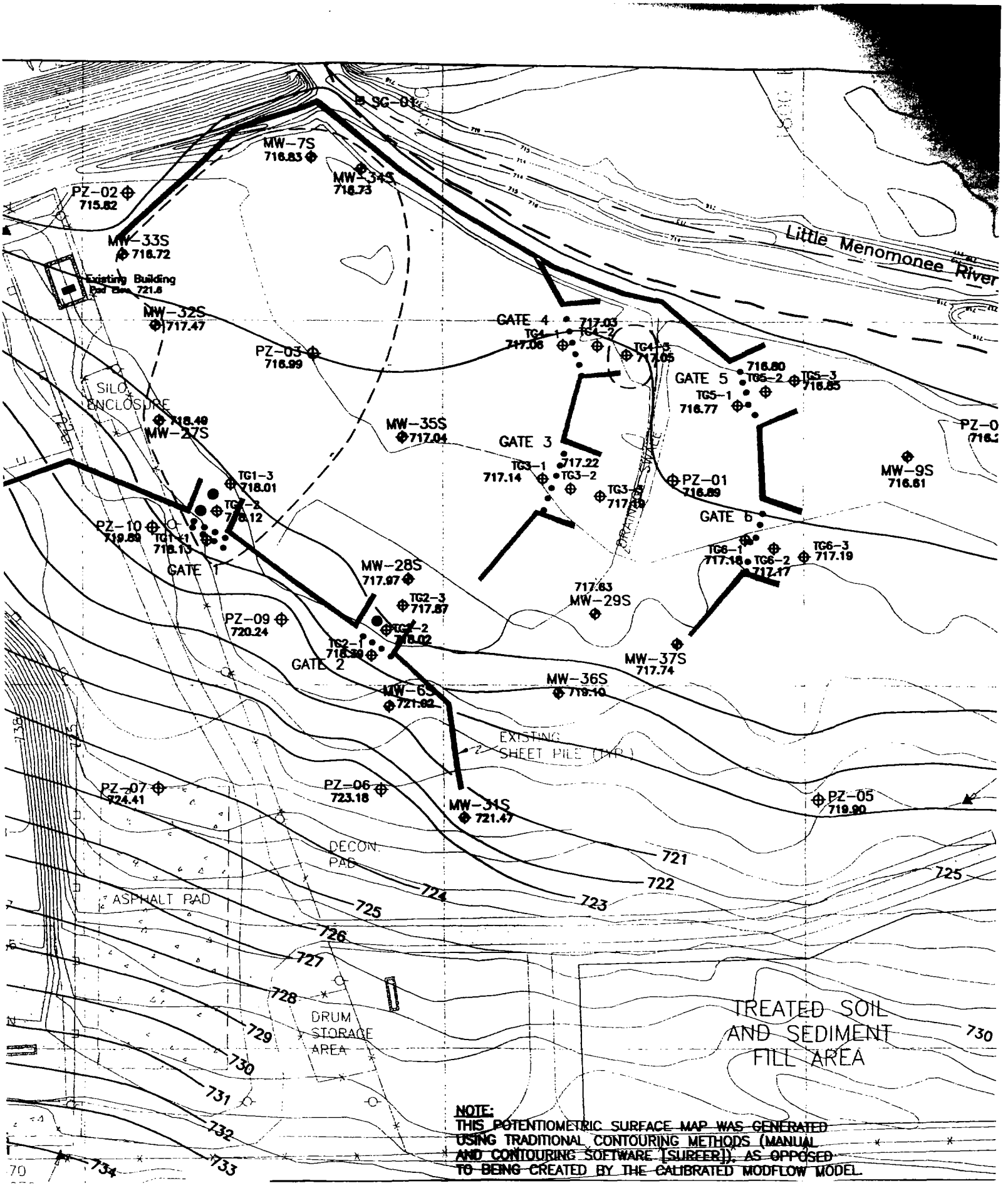
Photo Archive 9 - Fall 2004

Concrete barricades surround soil piled in the wetlands in Segment 2. These barricades, along with 10-15 feet of plastic, will keep the piles in place. A silt fence made of plastic has also been placed around the edge of the piles as an extra safety measure. (July 2004)

Completed new channel in Segment 3. (July 2004)

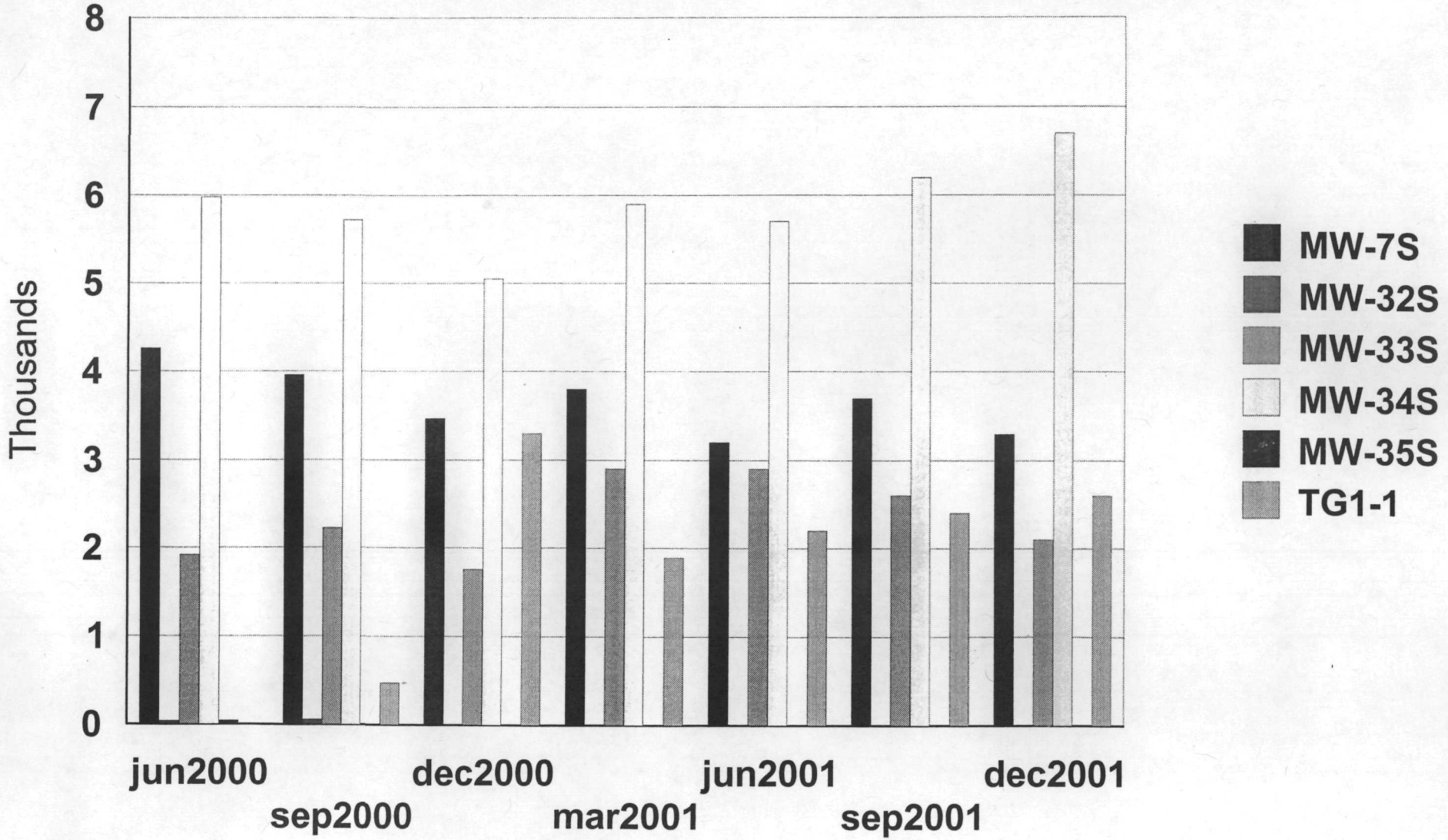
A backhoe shovels clean soil into the abandoned channel while a bulldozer (in the background) levels the newly filled-in channel in segment 2. (September 2004)

A backhoe digs out part of the old channel that will continue to be used due to the crossover of segments 2 and 3 north of the Calumet Bridge. (September 2004)

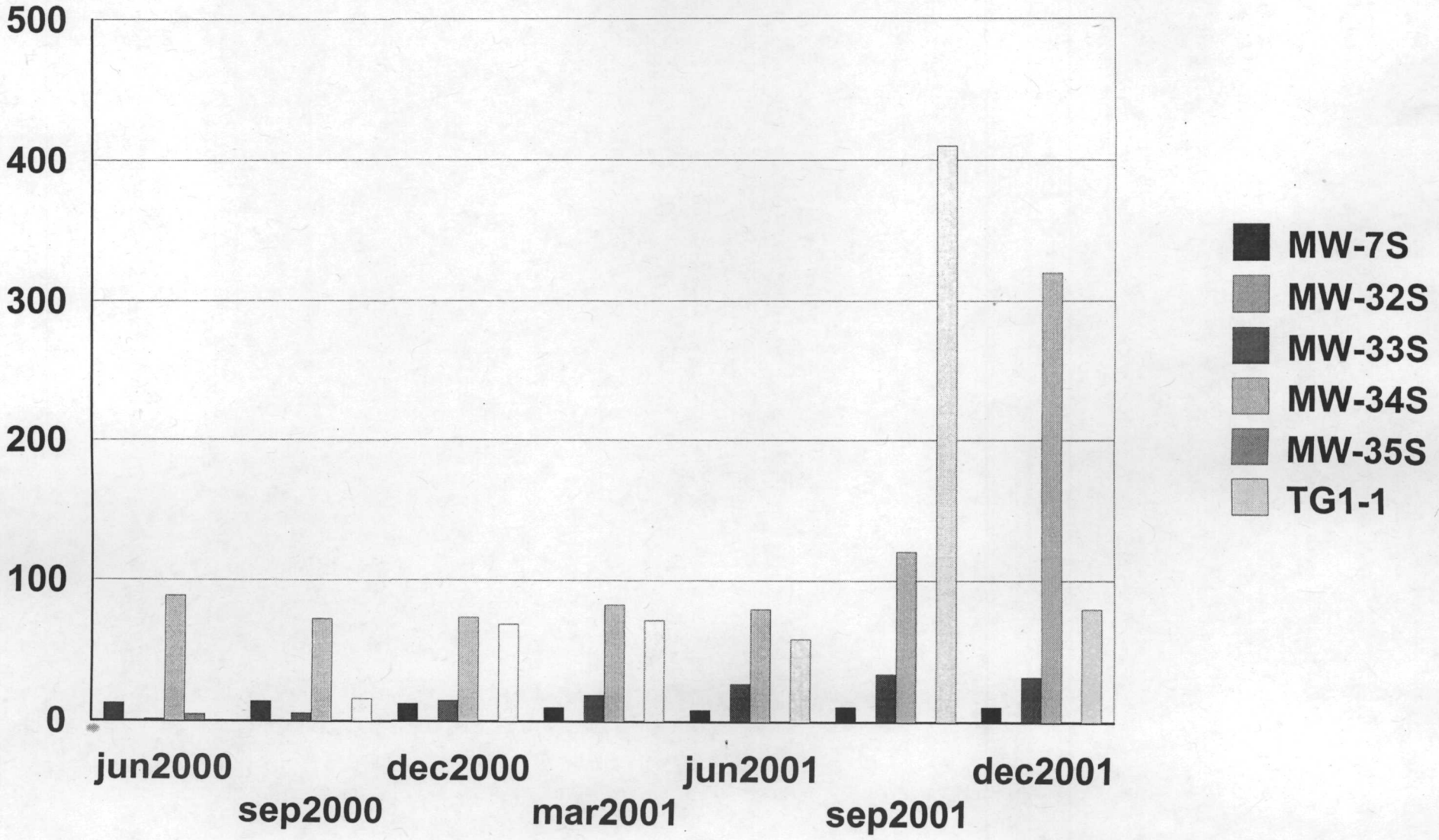


NOTE:
THIS POTENTIOMETRIC SURFACE MAP WAS GENERATED USING TRADITIONAL CONTOURING METHODS (MANUAL AND CONTOURING SOFTWARE [SURFER]), AS OPPOSED TO BEING CREATED BY THE CALIBRATED MODFLOW MODEL.

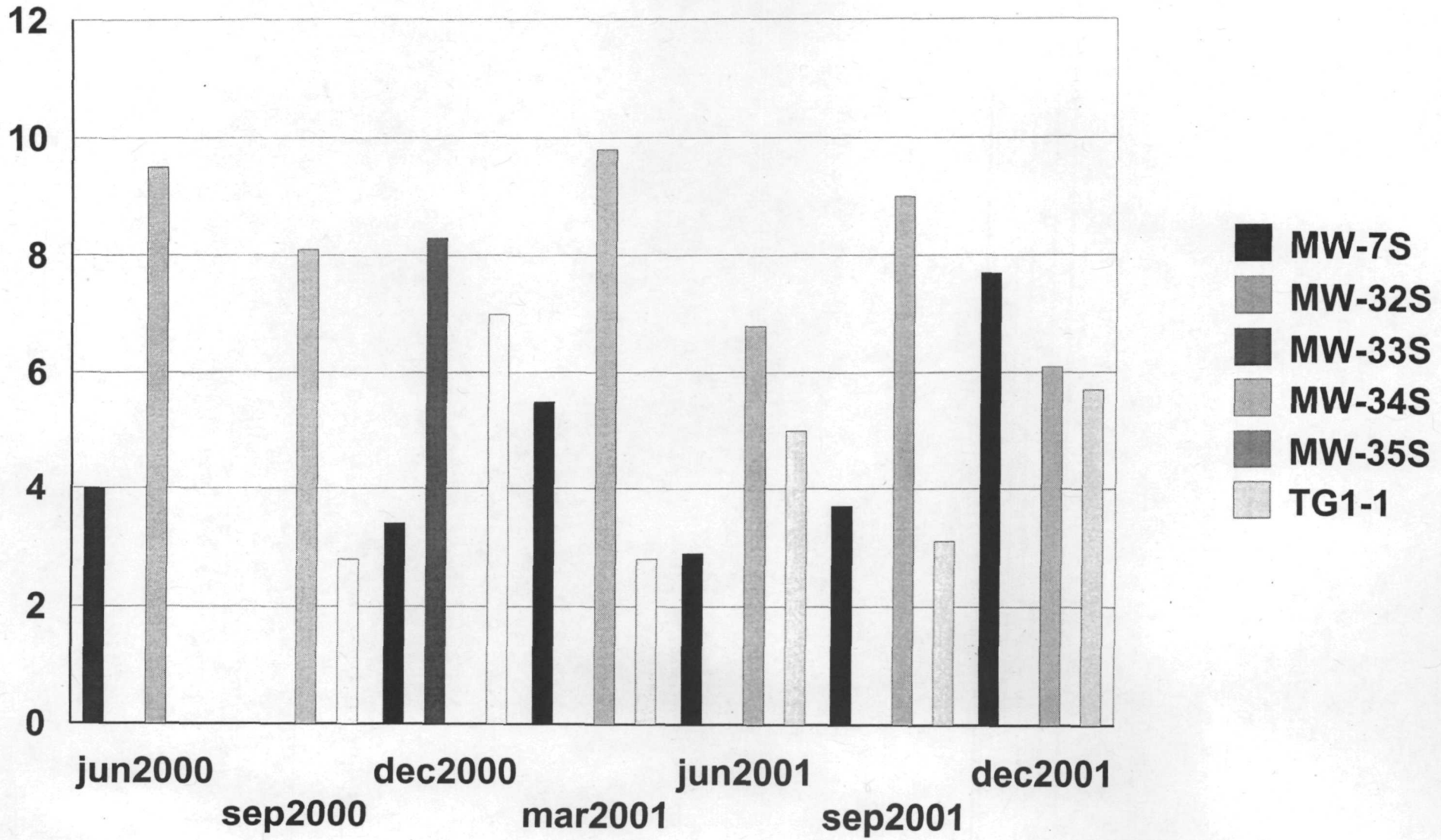
Naphthalene - 2000/2001



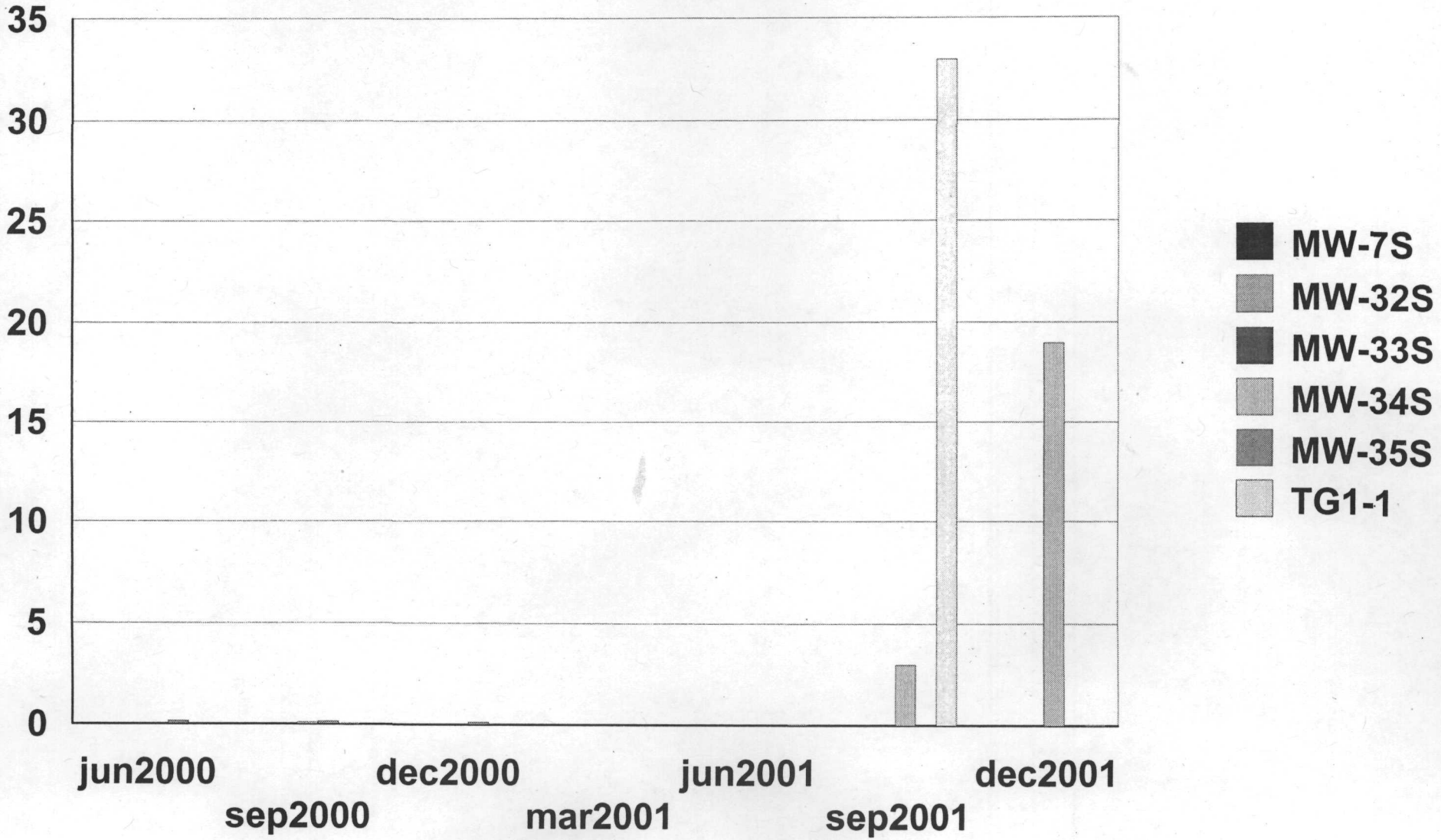
Fluorene - 2000/2001

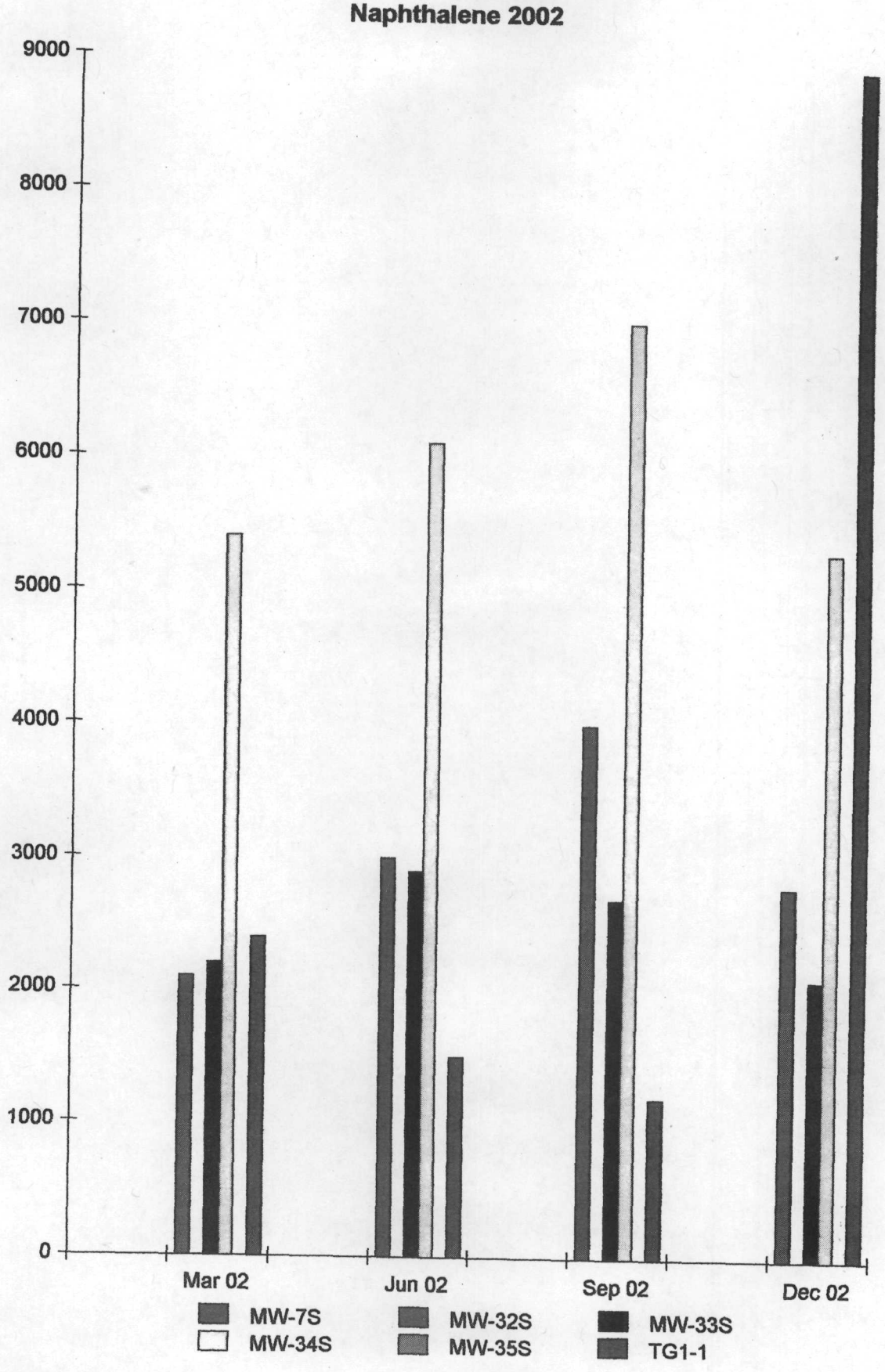


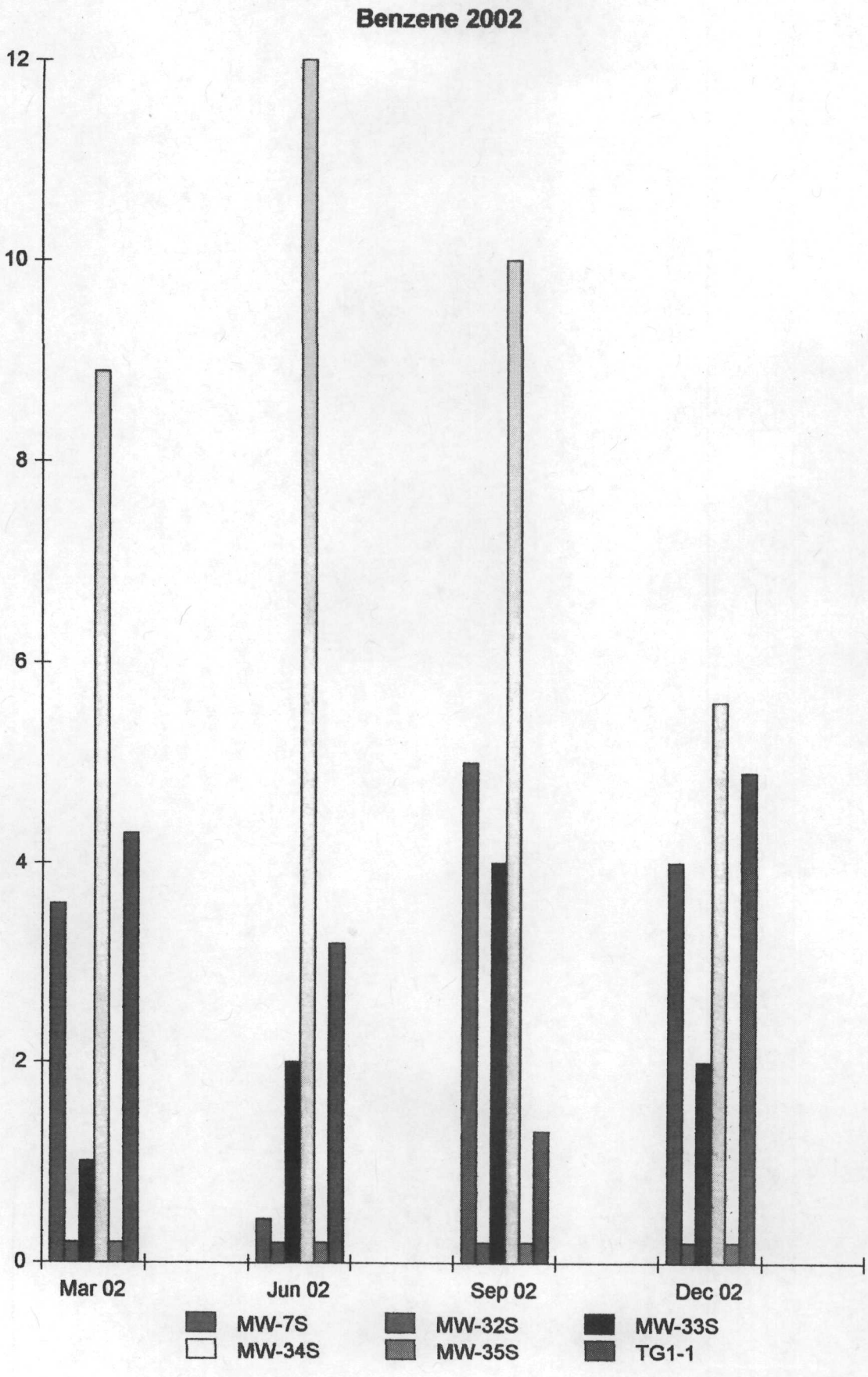
Benzene - 2000/2001



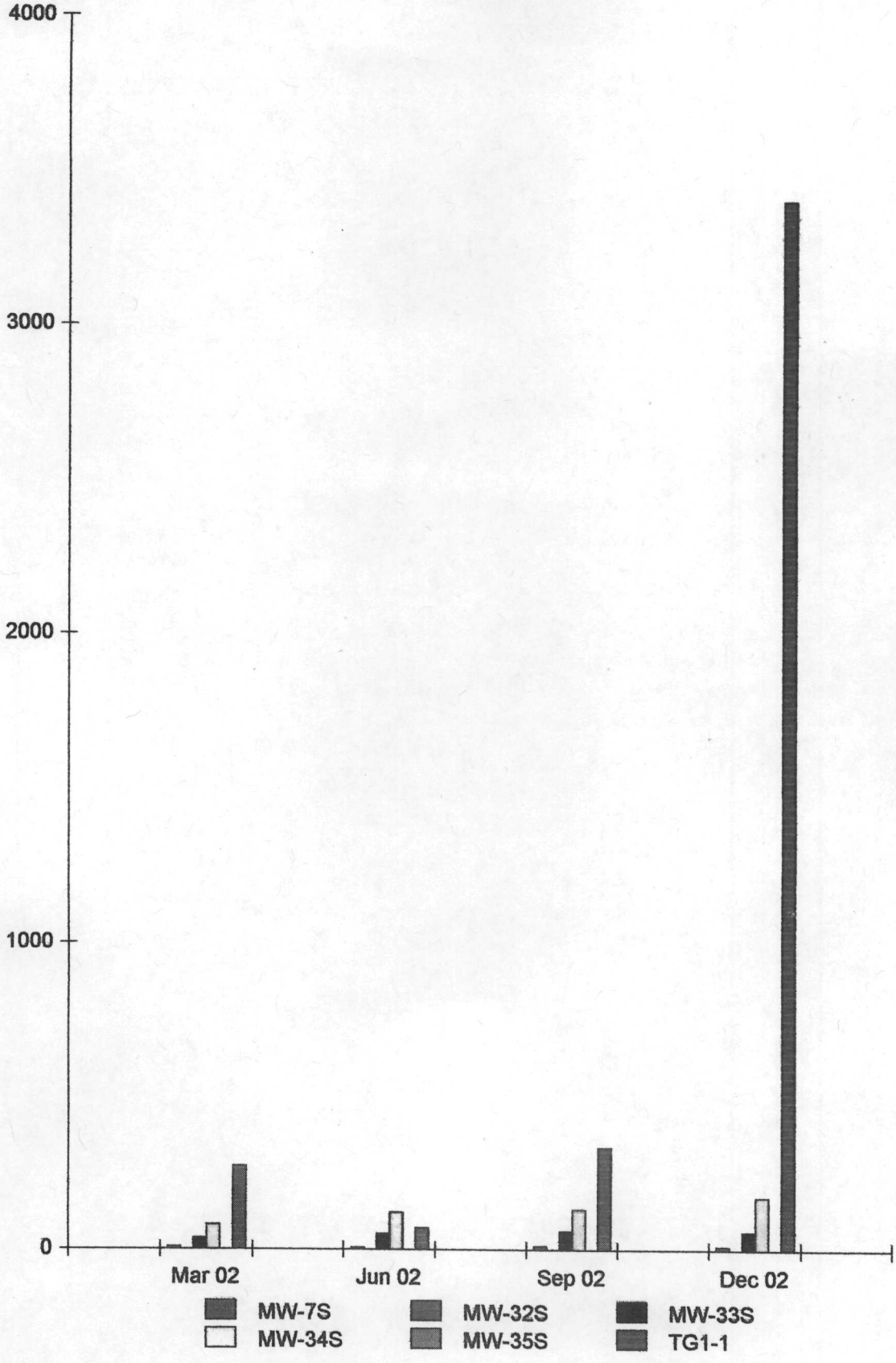
Benzo(a)pyrene - 2000/2001



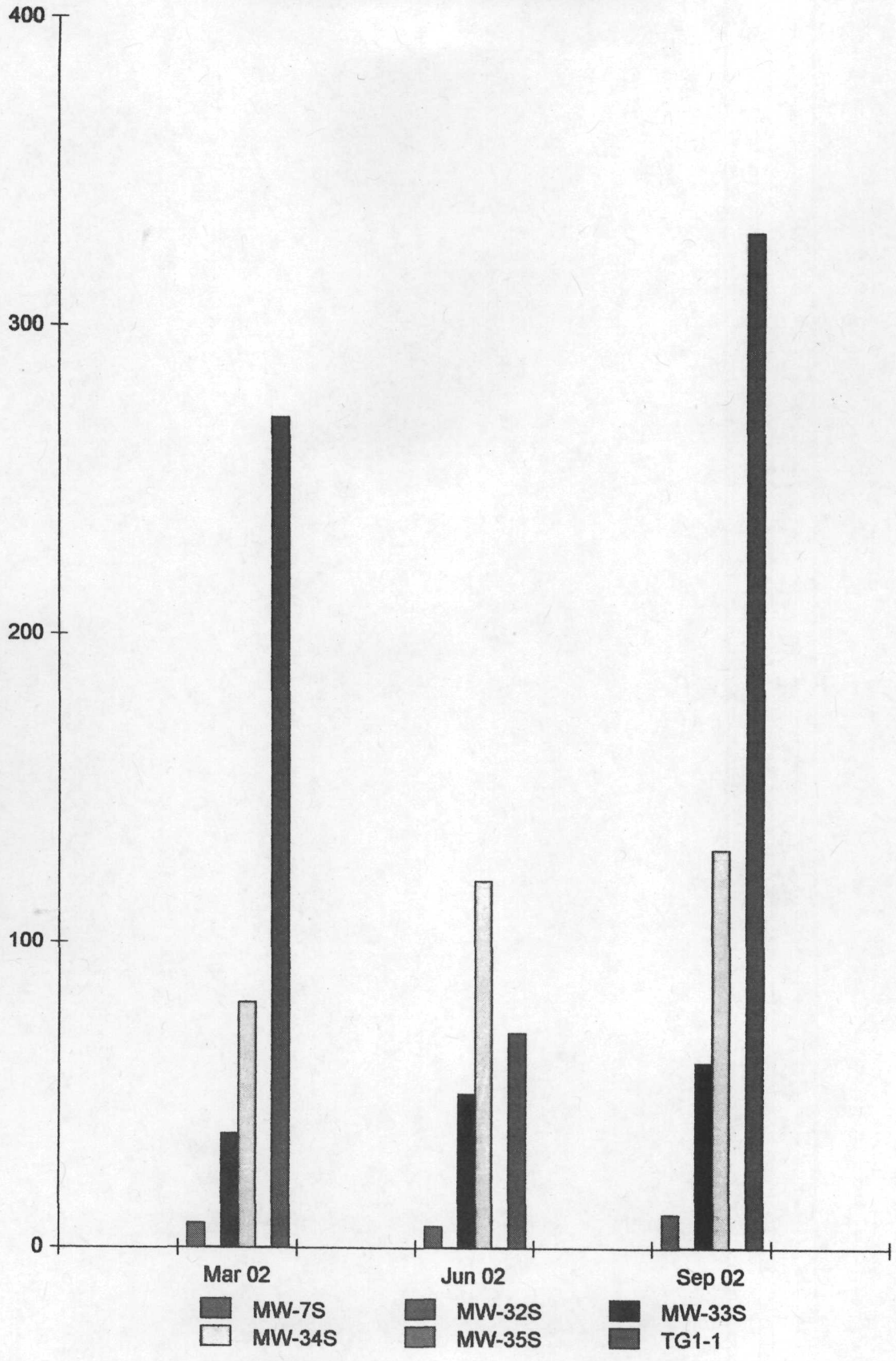

Naphthalene 2002
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Mar 02
Jun 02
Sep 02
Dec 02
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1


Benzene 2002
12
10
8
6
4
2
0
Mar 02
Jun 02
Sep 02
Dec 02
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1

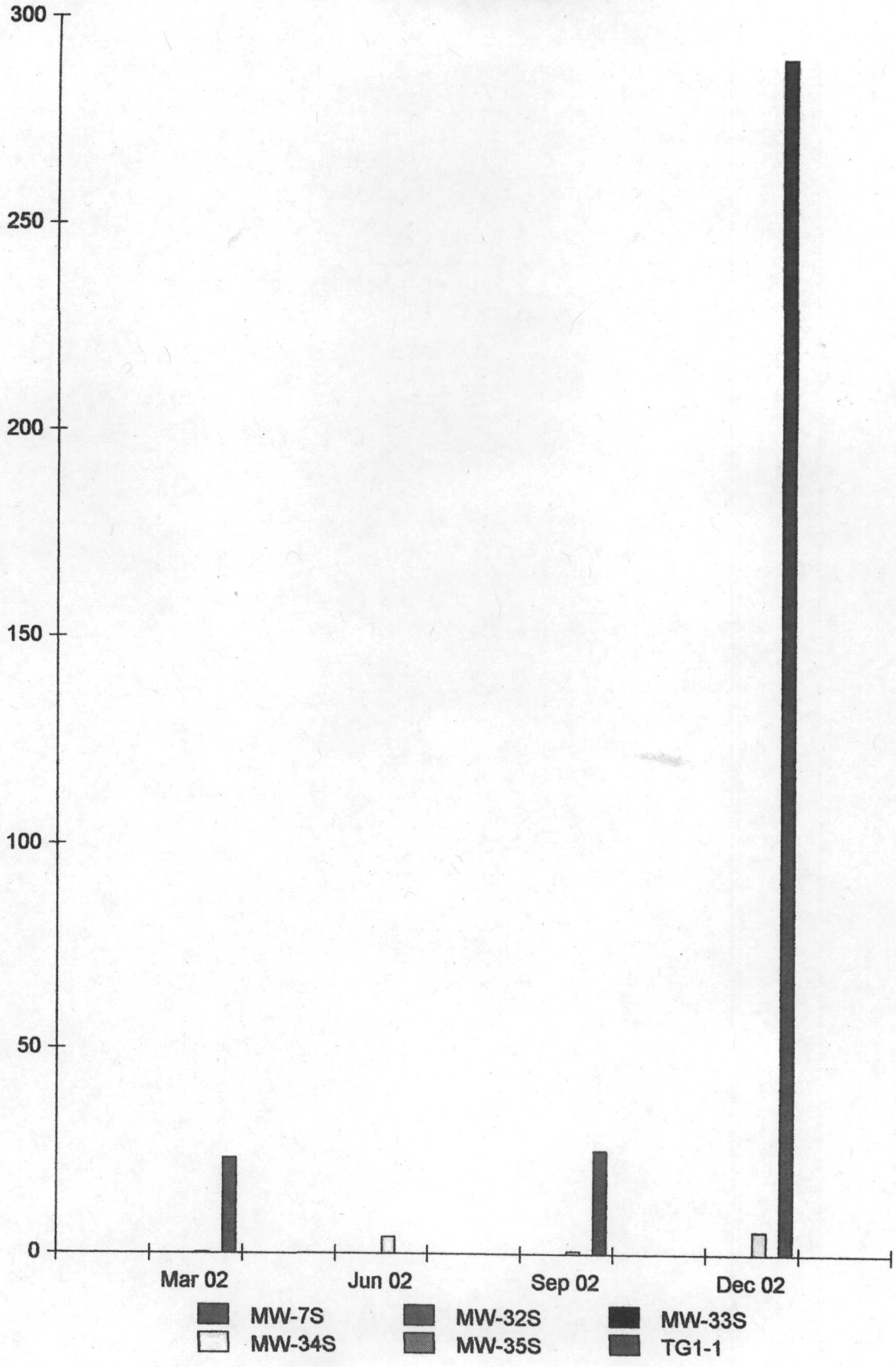
Fluorene 2002

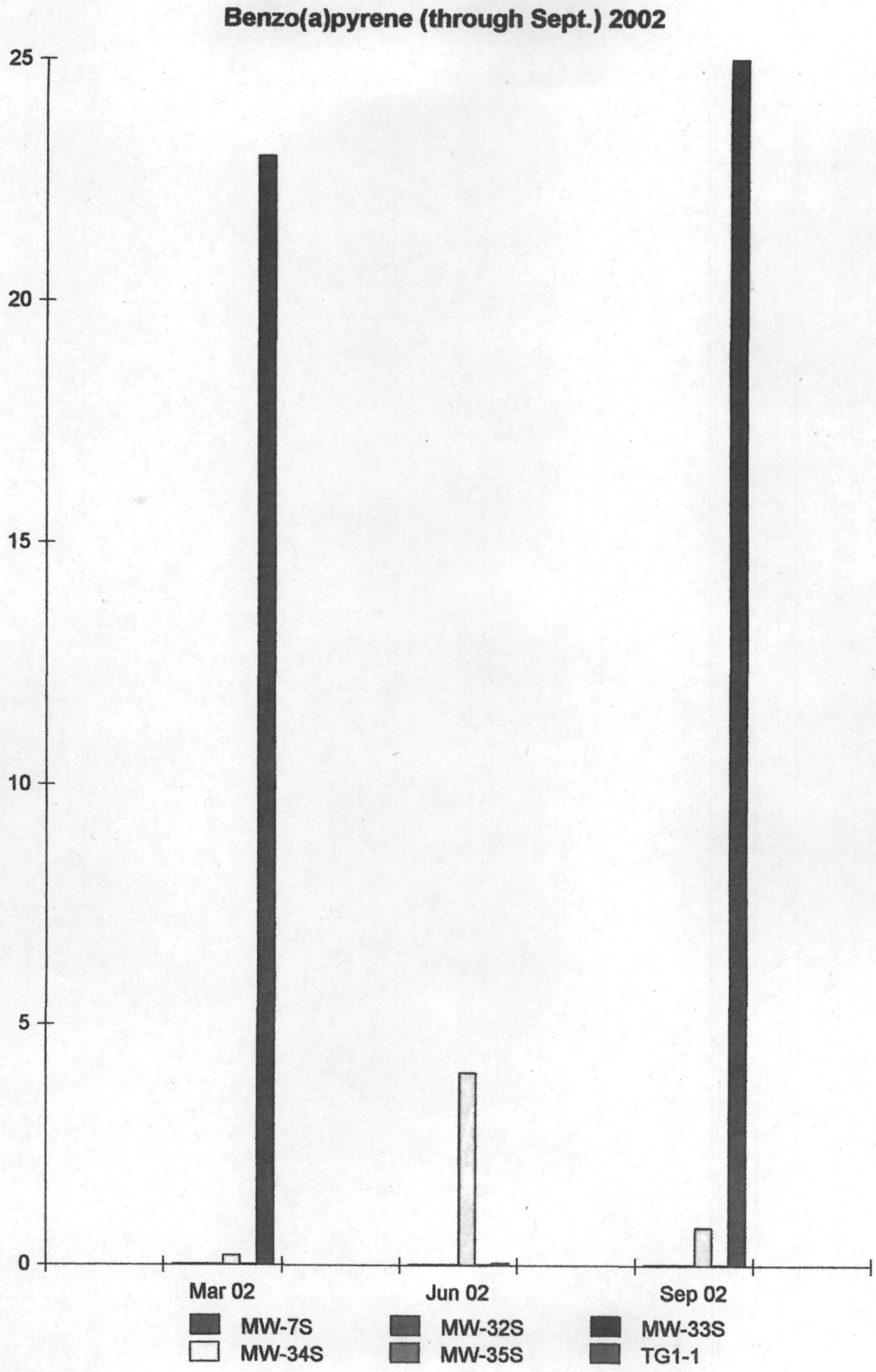


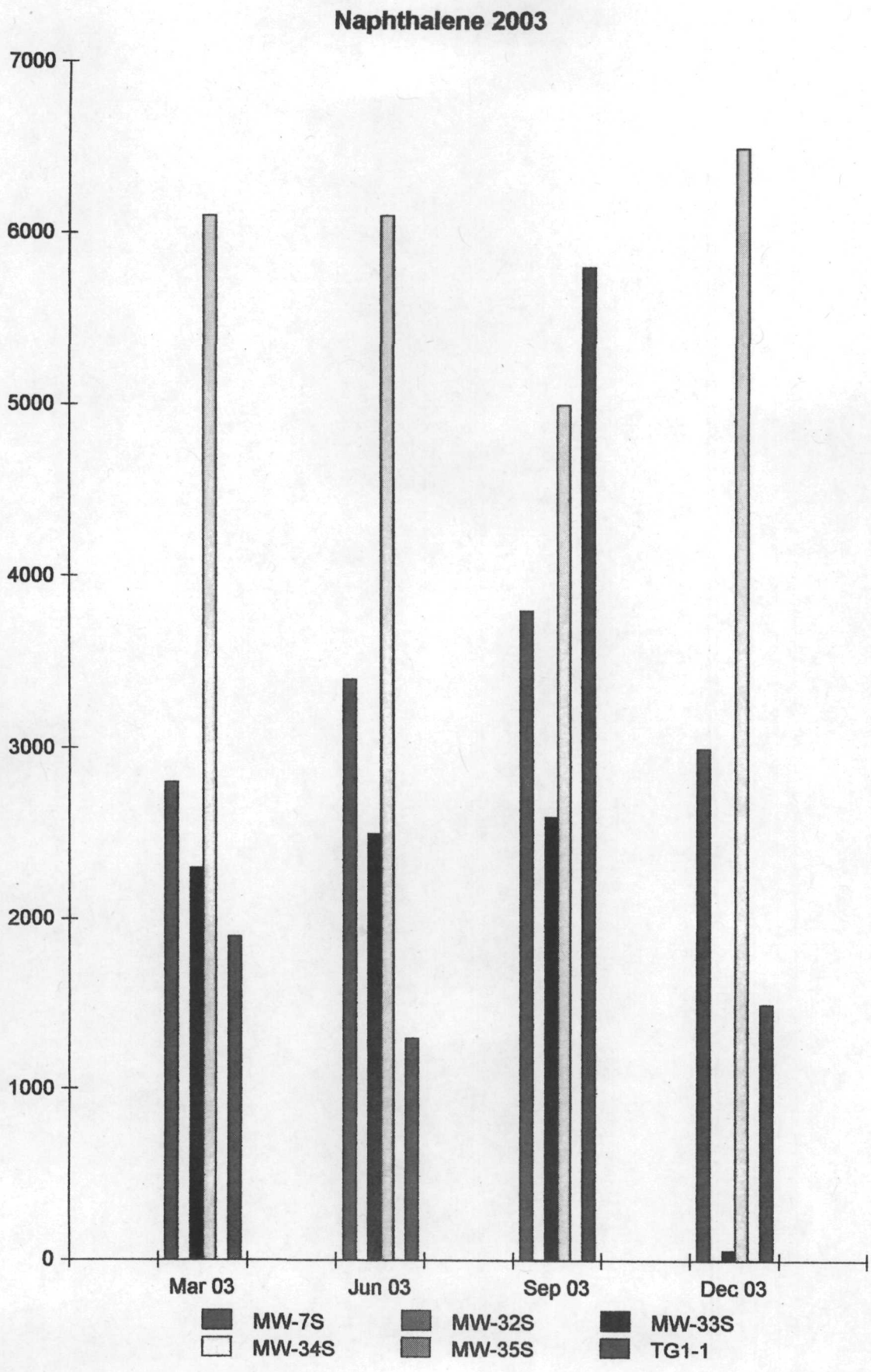
Fluorene (through September) 2002



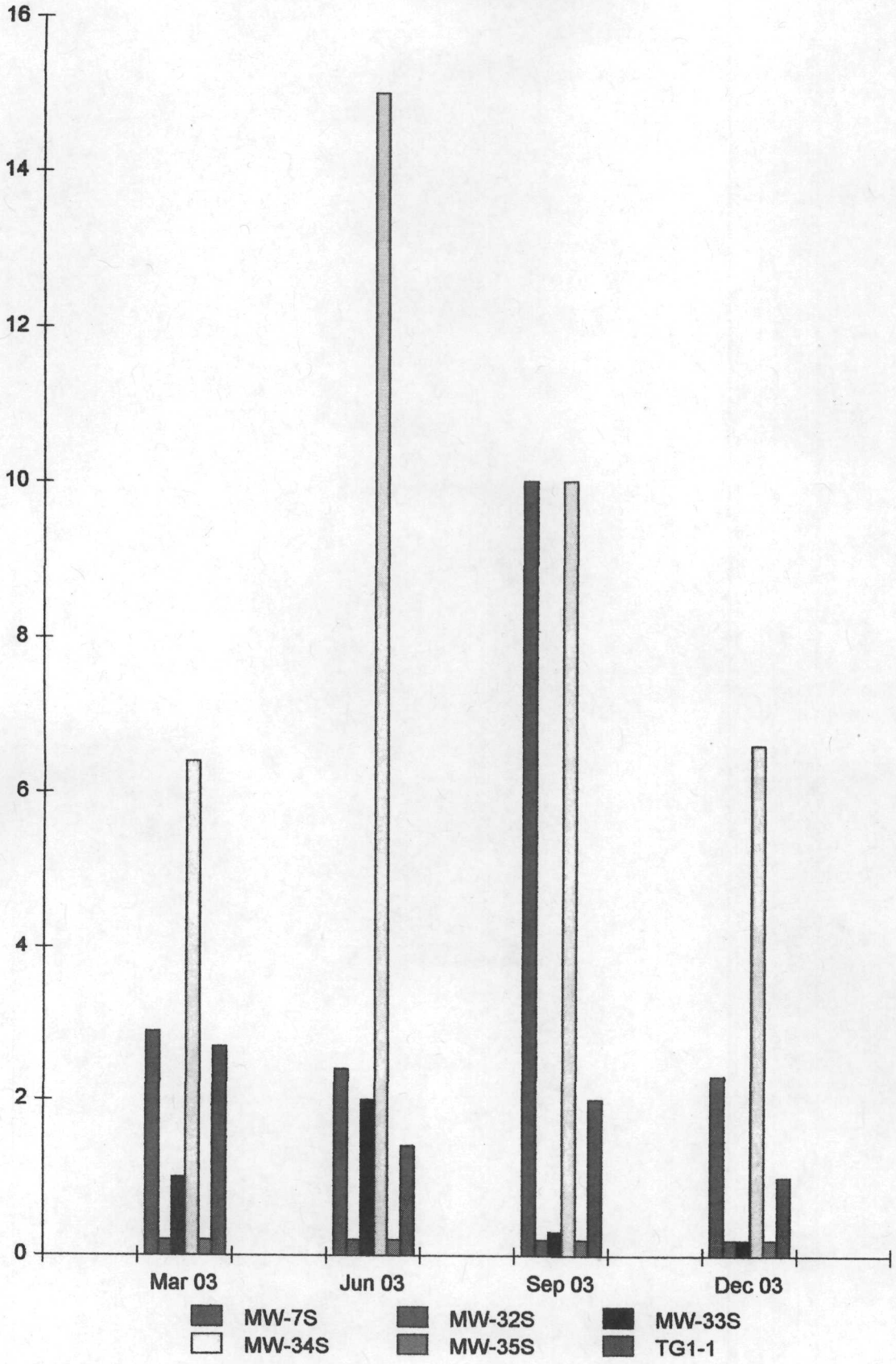
Benzo(a)pyrene 2002

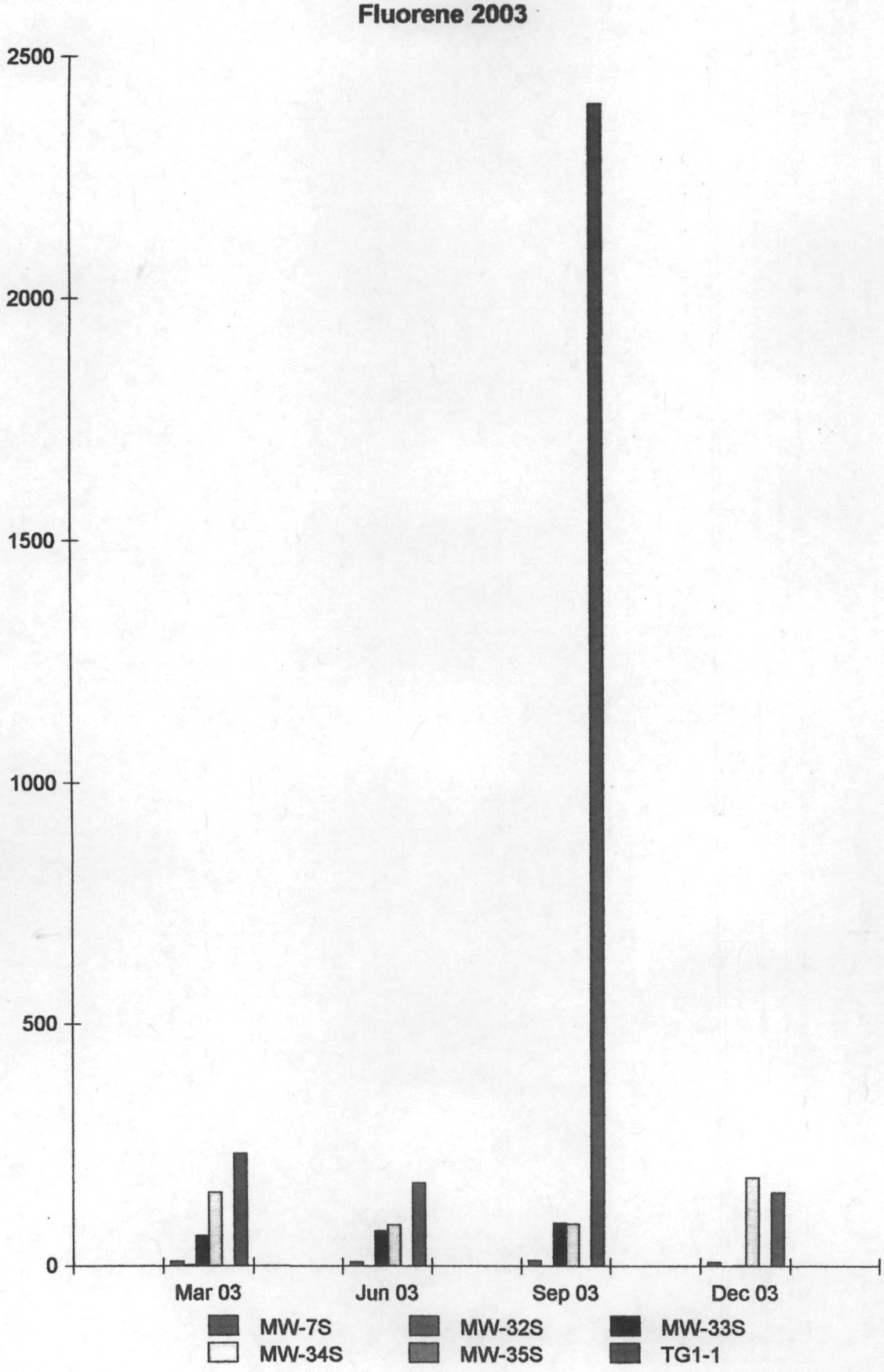



Benzo(a)pyrene (through Sept.) 2002
25
20
15
10
5
0
Mar 02
Jun 02
Sep 02
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1


Naphthalene 2003
7000
6000
5000
4000
3000
2000
1000
0
Mar 03
Jun 03
Sep 03
Dec 03
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1

Benzene 2003




Fluorene 2003
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1500
1000
500
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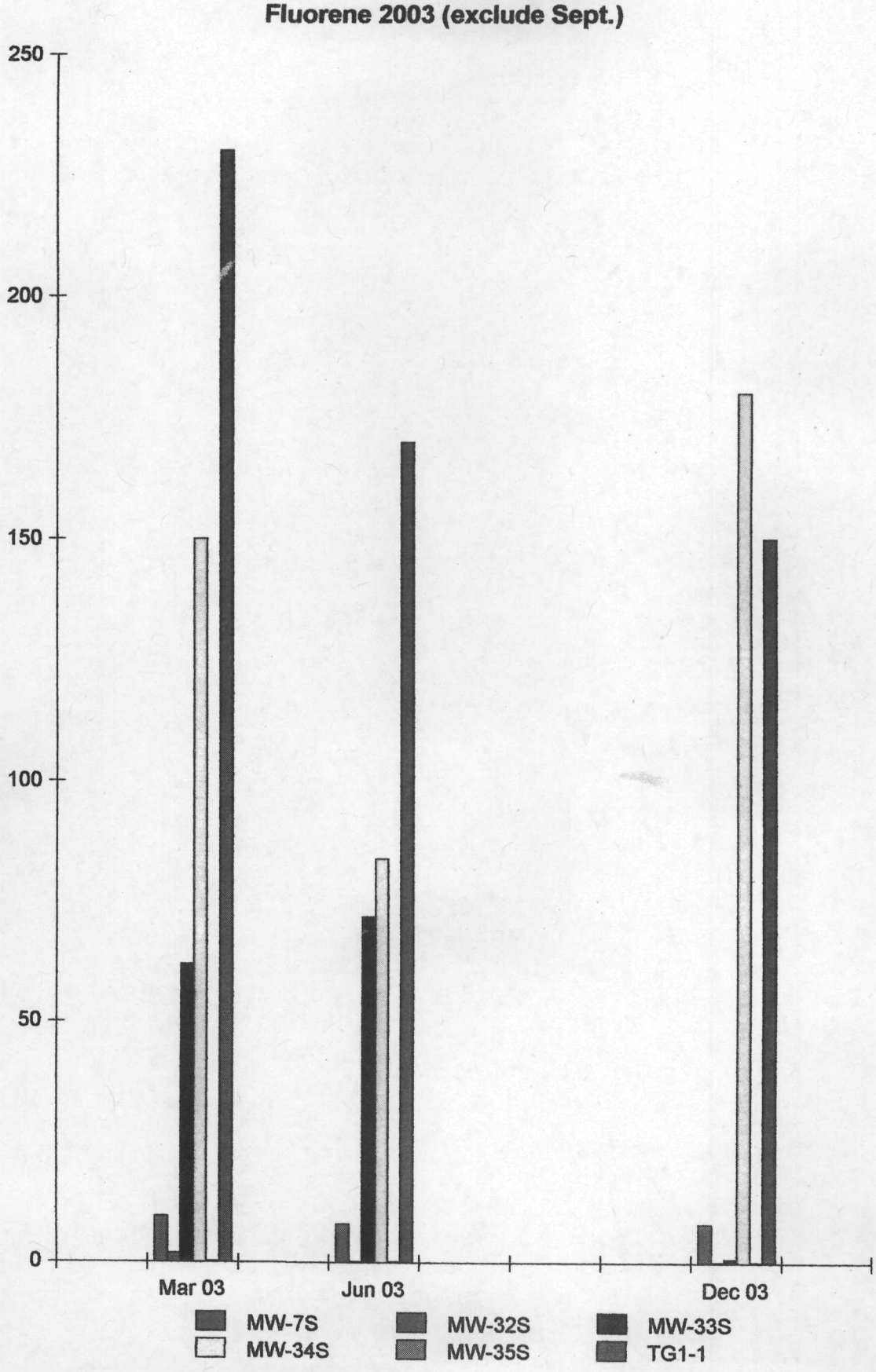
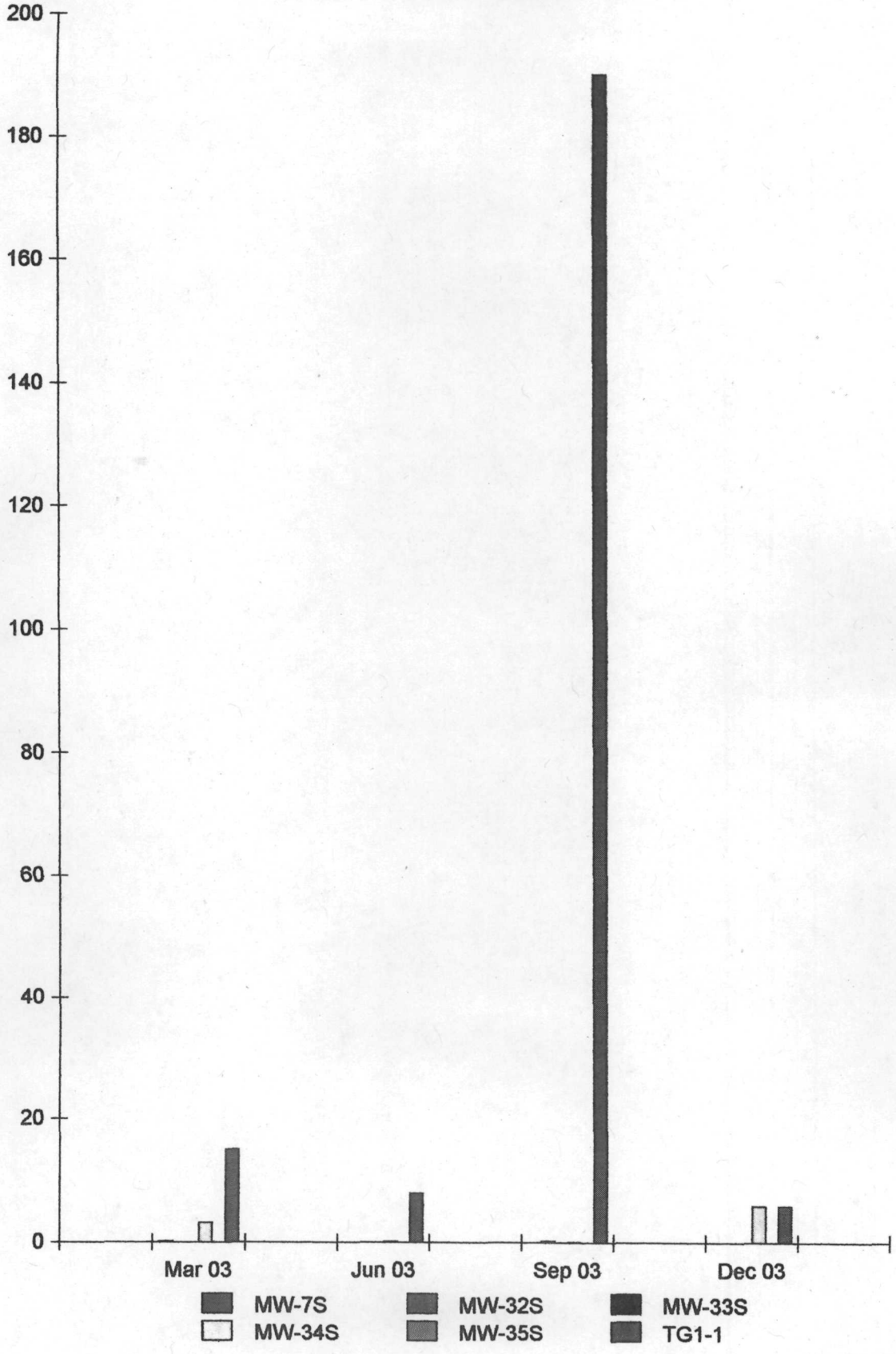
Jun 03
Sep 03
Dec 03
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1


Fluorene 2003 (exclude Sept.)
250
200
150
100
50
0
Mar 03
Jun 03
Dec 03
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1

Benzo(a)pyrene 2003



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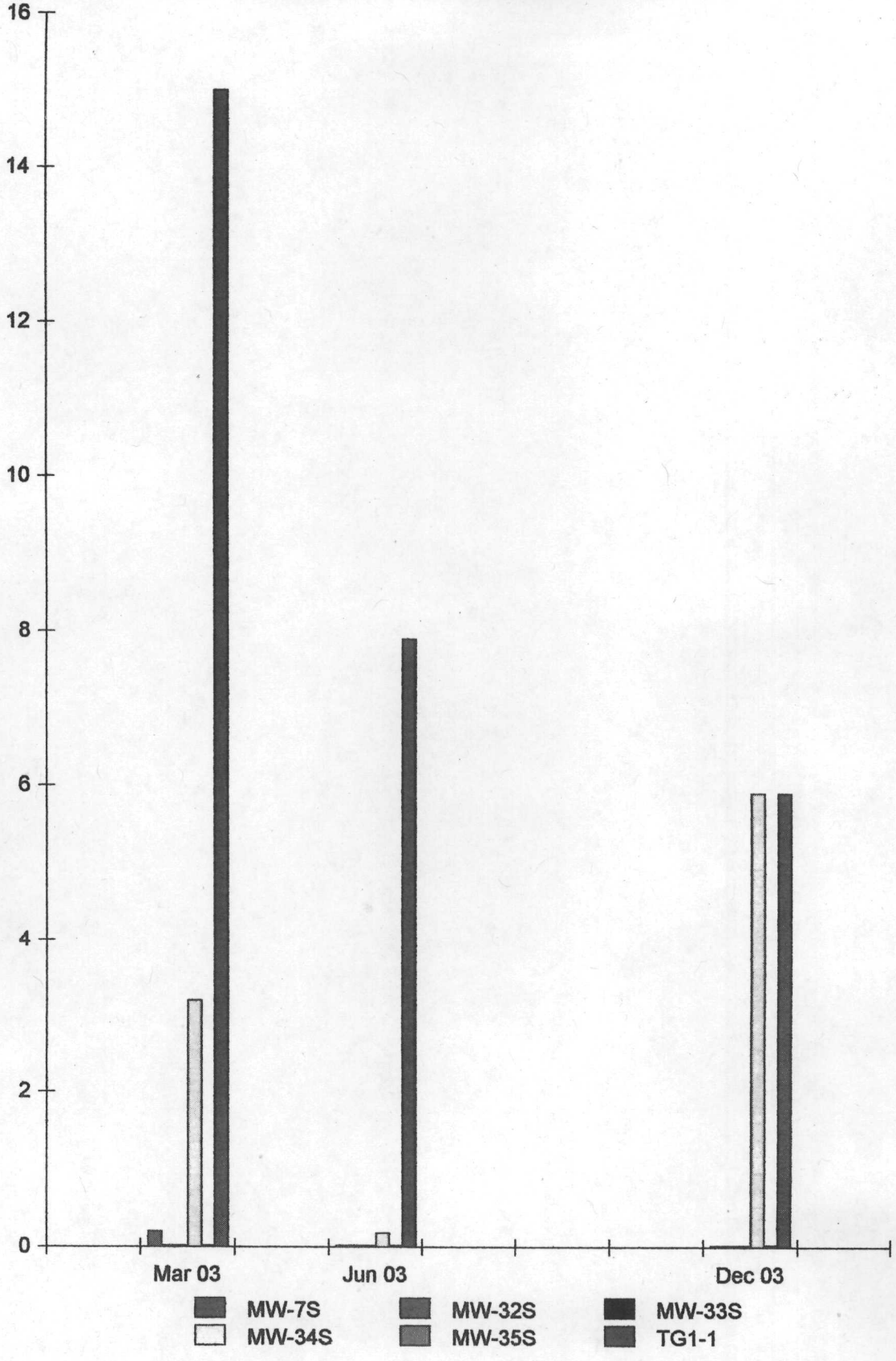
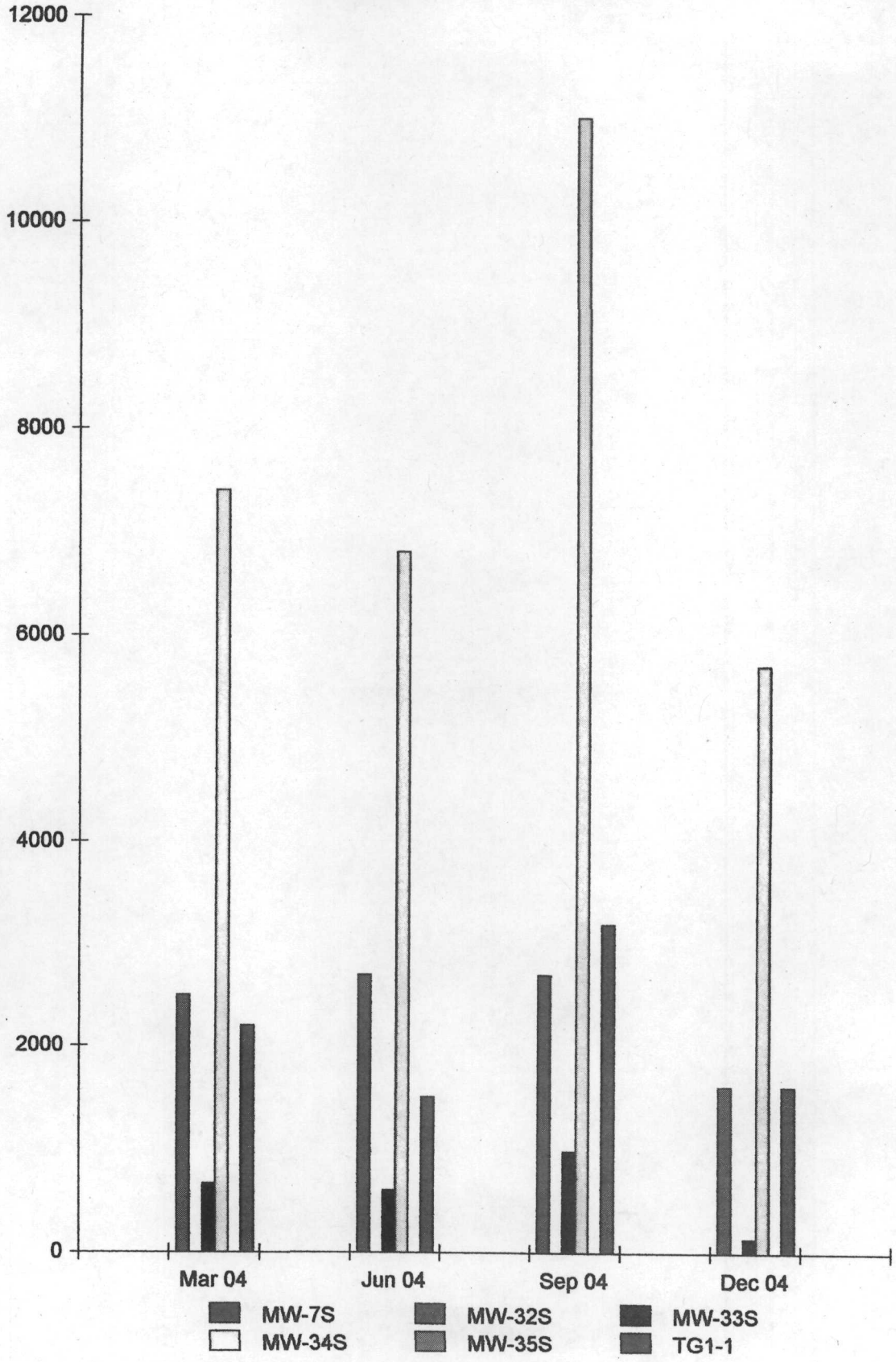
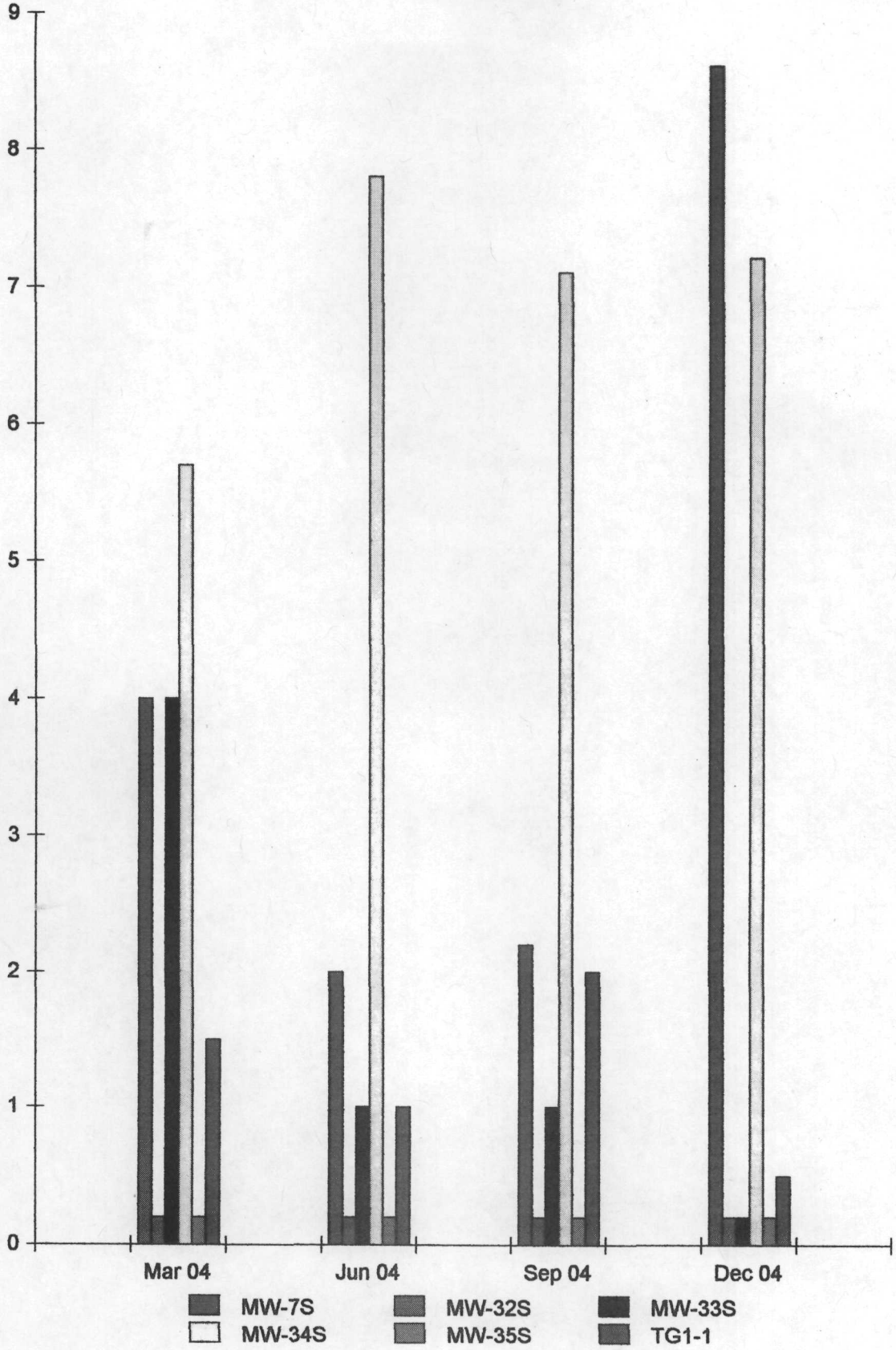


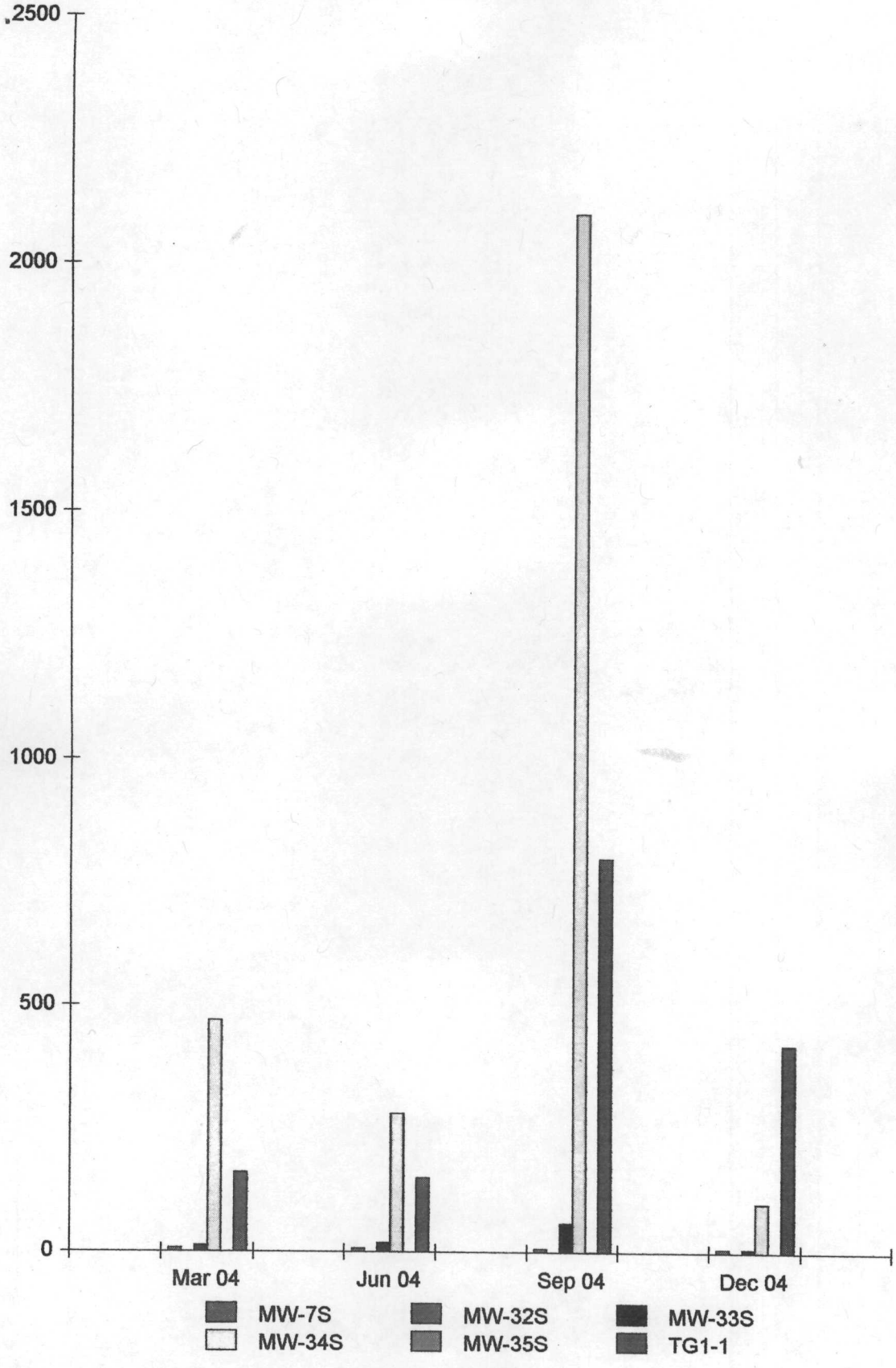
Naphthalene 2004

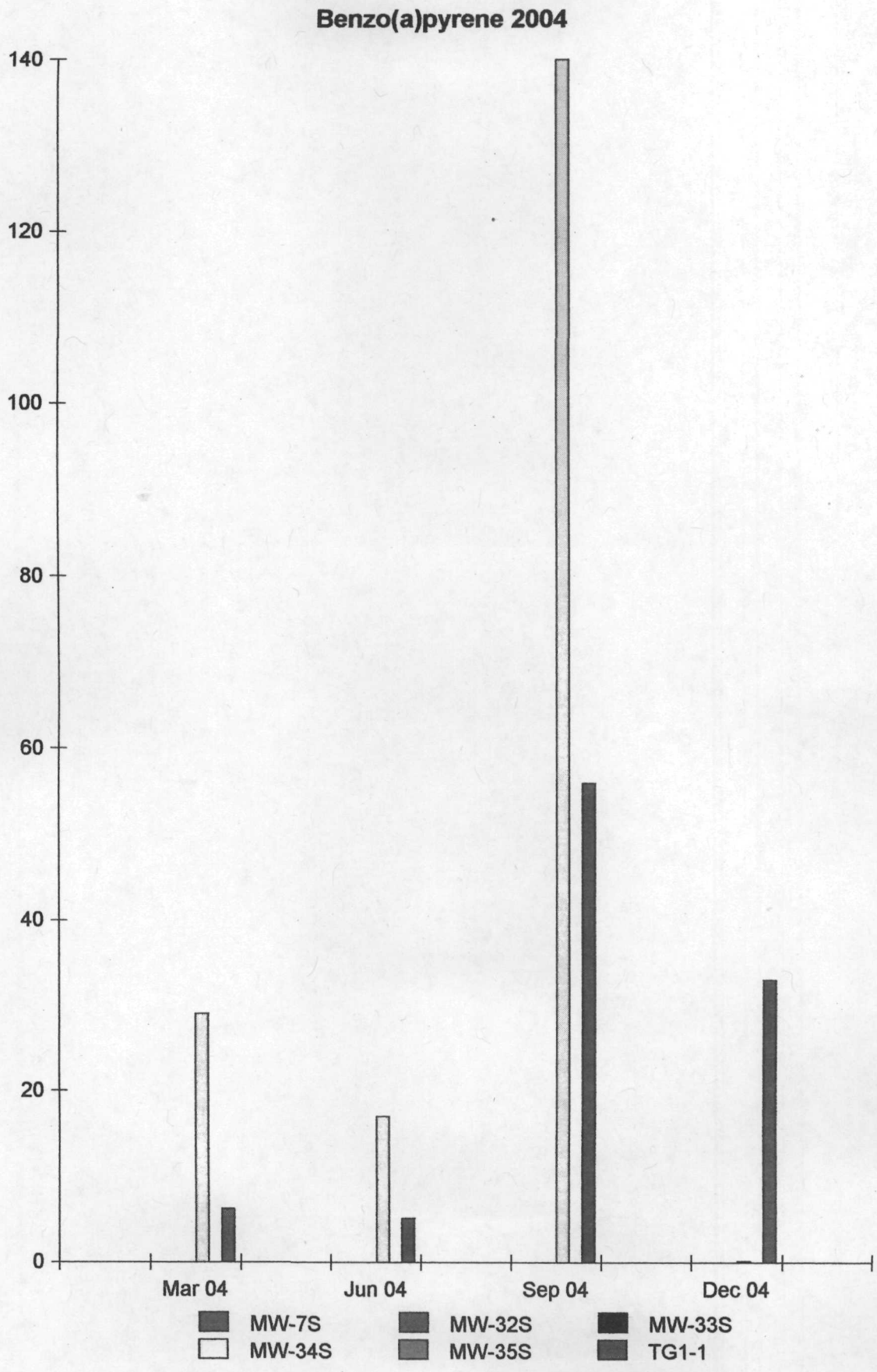


Benzene 2004

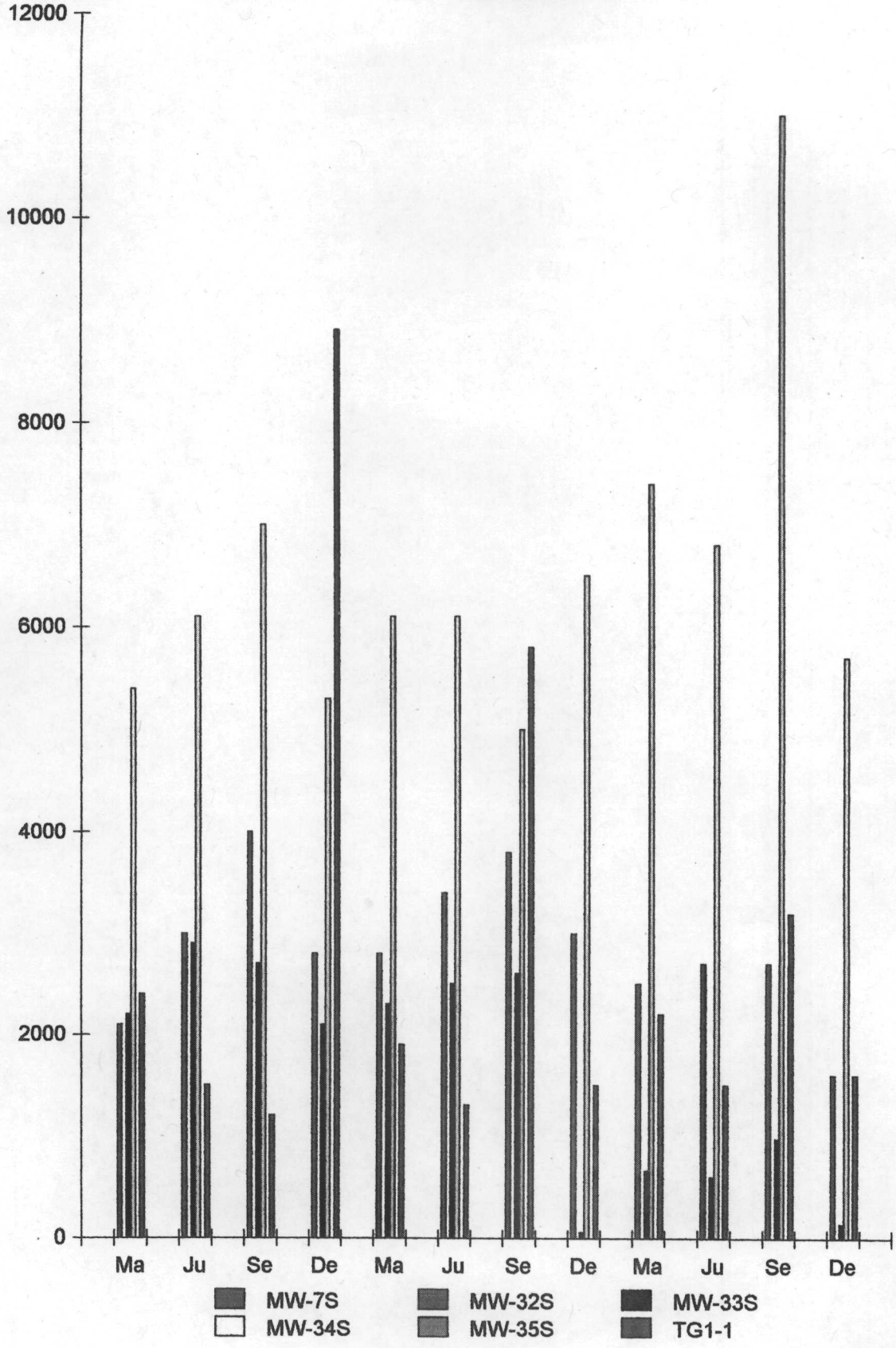


Fluorene 2004

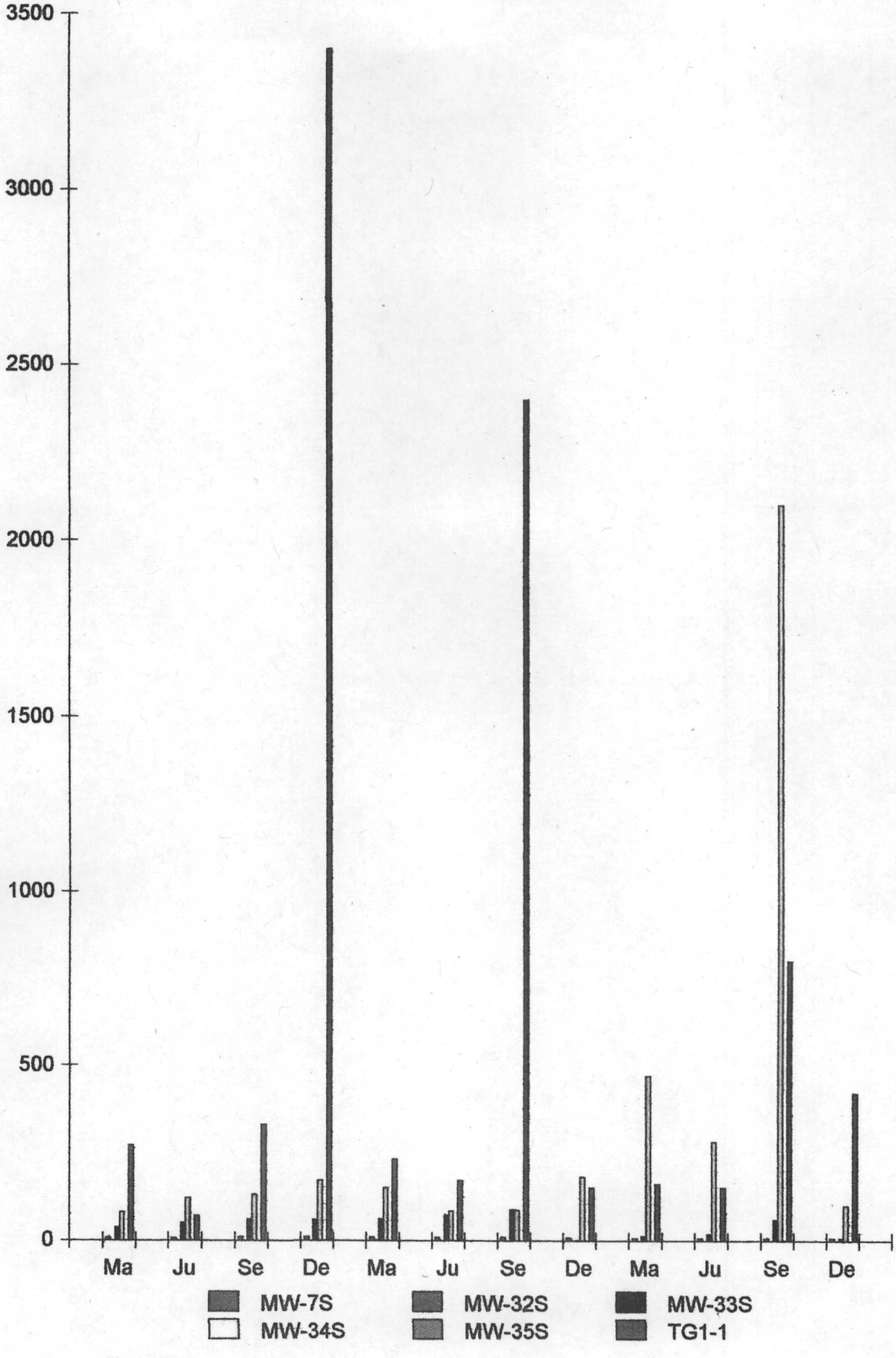



Benzo(a)pyrene 2004
140
120
100
80
60
40
20
0
Mar 04
Jun 04
Sep 04
Dec 04
MW-7S
MW-34S
MW-32S
MW-35S
MW-33S
TG1-1

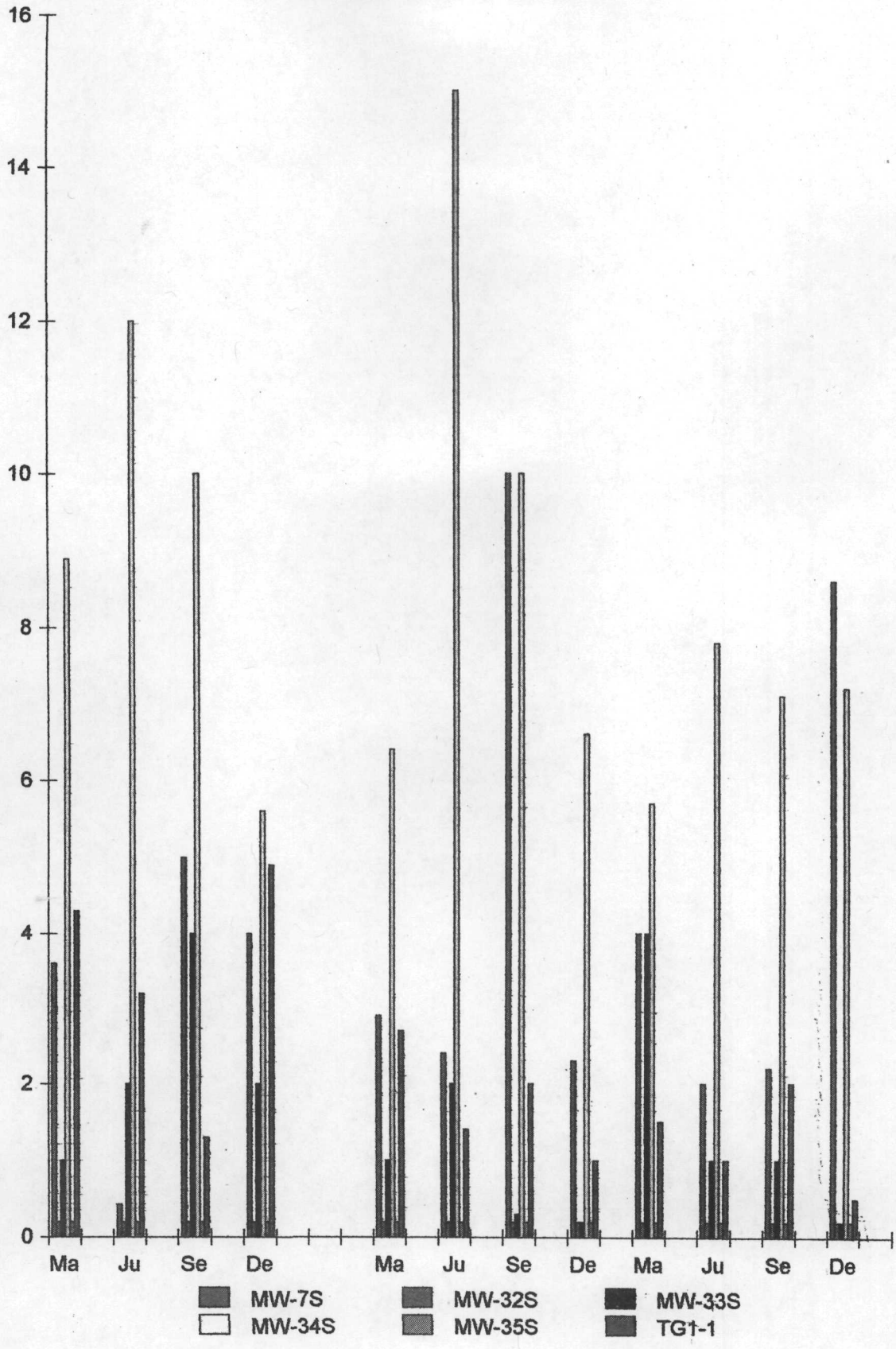
Naphthalene 2002-2004



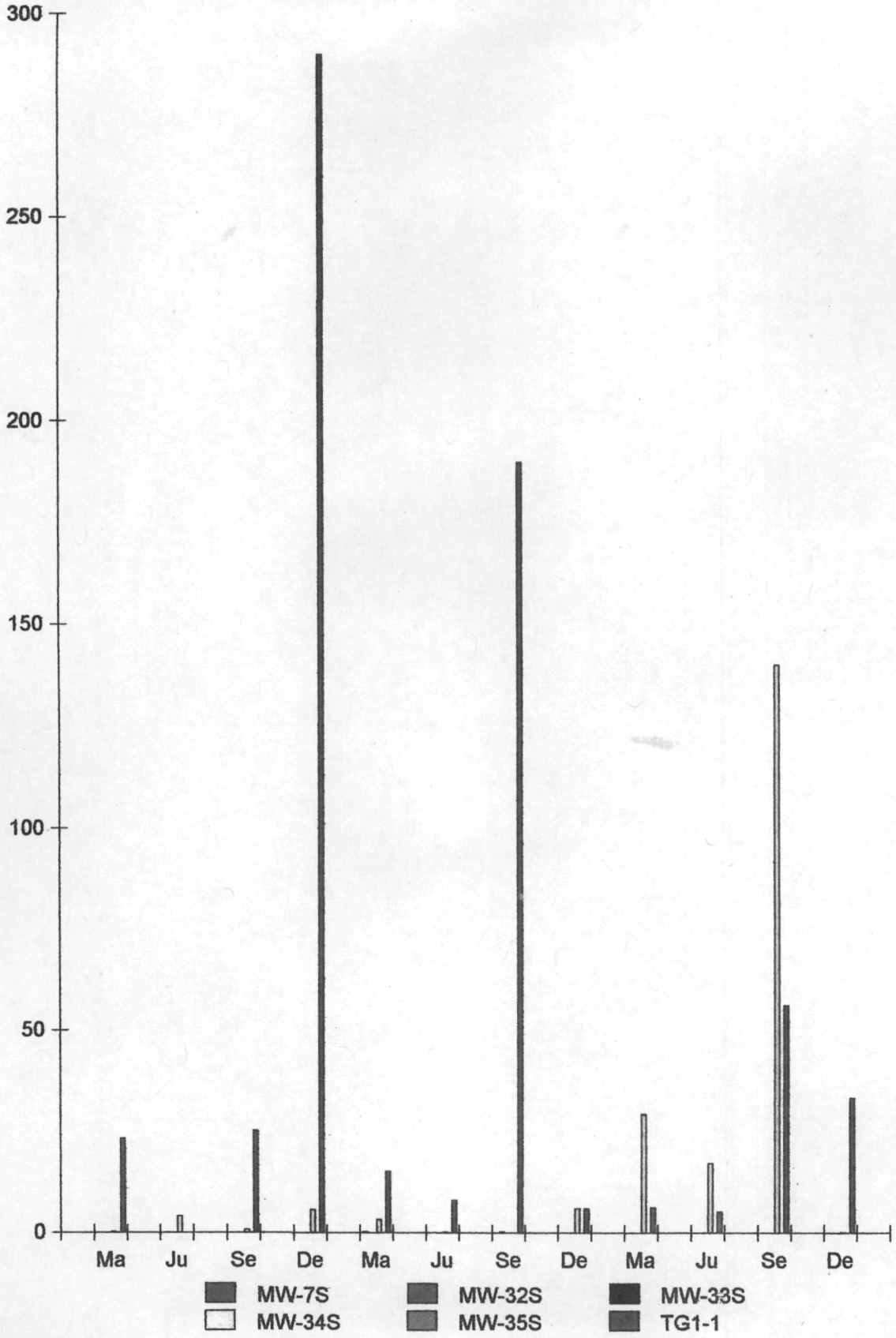
Fluorene 2002-2004



Benzene 2002-2004



Benzo(a)pyrene 2002-2004



to the groundwater funnel and gate collection and treatment system, very good contaminant removal efficiency is occurring at the more upgradient treatment gates. Typically, naphthalene concentrations drop from around 4000 ug/l to 40-80 ug/l to 8-10 ug/l as groundwater flows from the upgradient side of the gate, into the gate treatment zone itself, and past gates one and two.

Soils treatment utilizing low temperature thermal desorption attained remedial goals. As is discussed above, there was one short-term exceedance of desired volatile organic compound levels at the site perimeter; however this exceedance did not recur.

The sediments management component of the remedy is not yet complete. Observation of work performed to date in Segments 1-3 indicate that remedial goals for CPAH cleanup in the stream bed have been attained, and the desirable features, such as pools and riffle areas, that were introduced into new channel areas, appear well established. Continued observation and care must be taken with regard to revegetation survival rates, and control of invasive species. However, initial results for Segments 1-3 also appear encouraging in this regard.

- *Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?*

The 1998 ROD amendment recognized that areas at the former creosote plant are predominantly industrial in nature, and that cleanup levels to industrial/commercial levels are appropriate provided land use is restricted to industrial use and restrictions are implemented and maintained by the site property owners. The IC objectives are shown in the table below. An IC plan will be developed to evaluate the ICs.

Both WDNR and U.S. EPA will continue to monitor the scientific literature concerning future developments or findings with regard to key site contaminants of concern. The question of vapor intrusion, which has caused concern with regard to migration pathways at some other sites, does not appear to pose difficulty at Moss-American. Volatile organic compounds at Moss-American are a relatively minor constituent compared to levels of CPAHs, which are the primary contaminants of concern. At the present time, pertinent exposure assumptions, toxicity data, cleanup levels, etc., remain valid.

Restricted Areas (areas that do not support UU/UE)	**IC Objective/ Mechanism Identified in ROD**	**What IC is in place? Are changes needed?**
former wood treating facility were remediated to industrial and recreational standards and require land use restrictions (see map)	deed restrictions to prohibit residential use, non-industrial use, groundwater use, penetration of cover or use of portions of the property containing remedial action components.	The owners have recorded deed restrictions. An IC plan will be developed to evaluate the long term effectiveness of existing ICs.
Property on-site south of wood preserving plant property (see map)	Deed restrictions to prohibit interference with work or damage to remedial action component and, during the remedial action, unapproved construction. Deed restrictions requiring compliance with applicable laws and regulations governing wetland and floodplain habitats.	The County has recorded restrictions on approximately 18 pieces of property. An IC plan will be developed to evaluate the adequacy and the long term effectiveness of existing ICs, and determine whether there are other properties that need ICs.

. *Question C: Has any other information come to light that could call into question the protectiveness of the remedy?*

Both WDNR and U.S. EPA will continue to consider this question. At this time, it does not appear that information has been developed which would cause concern over the basic protectiveness of the remedy.

In attempting to attain the desired residual contaminant level for naphthalene in site soils, on May 11, 1999, having reviewed and discussed this matter with WDNR, the agencies indicated to Weston/KMC in a letter that we were being responsive to their request, and that WDNR felt it was possible to achieve the naphthalene RCL through a performance approach. The agencies indicated that rather than pick up and treat all soils having greater than 0.4 ppm naphthalene that the PRP could attempt to attain the groundwater RCL by picking up and treating all soils at the

100 ppm contour line for naphthalene, since the PRP demonstrated that 96% of the total naphthalene soil load came from areas having 100 ppm naphthalene or greater. As the letter and this Review Report indicate, the agencies reserve the right to have more soil addressed if the naphthalene groundwater situation does not ultimately improve. Hence it is possible to question whether not excavating and treating all soils in excess of the naphthalene RCL will ultimately provide sufficient protection. However, the soils that were excavated and treated appeared to contain the great majority of naphthalene soils loading. And, as noted the agencies retain a right to request further work in this area if needed.

As noted in the "Remediation Results" section of this report, soils having undergone low temperature thermal desorption treatment were tested to see if they attained RCLs. Testing was done by both Weston representatives, and spot checked through split samples by CH2MHILL as U.S. EPA's oversight contractor. On average, about 20% of all batches needed to be run through the LTTD unit a second time. After a second treatment, the great majority of treated soils attained RCLs. A few batches did not. It may be argued that failure to achieve total soil cleanup goals puts the ability of the remedy as executed to achieve desired protectiveness. However, after discussion of this issue with WDNR, if the violation stemmed from minor BTEX excess (which was the case) - these few batches were spread over ground at the funnel and gate groundwater treatment system. The reasoning was that if any substances leached out of the soils, they would be captured by a system compatible with their further treatment.

It may be debatable as to how "engineered" the cover over the old channel is - but disturbance should be minimized, partially through IC - and partially through future/continuing observation. The question of PAHs or other substances migrating from the old channel will require continuance of monitoring efforts now underway. No detection of undesirable contaminant migration from filled in old channel sections has been noted to date. The act of taking out the "visibly contaminated" materials prior to backfill has helped alleviate the chance of such occurrence. However, as noted, the old channel sections are not Unlimited Use/Unrestricted Exposure zones, and the potential for contaminant migration exists.

In considering what remains, it may be appropriate to consider future complexity of soil/sediment monitoring obligations to discuss work completion. If, after performing sediment management, the proposal is along the lines of adding the final cap as the CAMU unit suggests, some questions on what is in areas not picked up, excavated and treated is moot - although there could be some light sampling done to define cap limits. But, if an alternate approach is made making note of the increased reliance made of taking certain residuals off site, with an inference that no cap is needed, then the final soil compliance demonstration sampling burden may be more complex. This consideration may be of more importance in the next iteration of the Review Report process for the Moss-American site, when it is expected that all remediation construction work will be complete.

VIII. Issues

There are several issues which need to be followed over both the short and long term at the Moss-American site. Some of these issues have a bearing on future remedy protectiveness. For other matters, it is prudent to monitor developments in means of treatment, sampling, or analysis. Issues pertaining to remedy protectiveness include:

1. Treatment gate 1 within the site's funnel and gate system appears to be functioning efficiently from the standpoint of reducing concentrations of contaminants of concern from the aquifer. The final two pairs of treatment gates are showing a "clean water in/clean water out" situation. However, monitoring wells downgradient of the first treatment gate, but upgradient of the final two gate pairs, indicate significant groundwater contamination in a relatively localized spot. During the June 28, 2005 site inspection, the parties discussed this situation. Several ideas were informally considered.

2. In a related item, KMC/Weston have approached the agencies with a proposal to modify the groundwater monitoring network. U.S. EPA is aware that it is advisable to update and optimize, if possible, long term monitoring efforts. In some cases, wells sampled may be more associated with past investigation efforts, whereas the focus should be on a network which will reliably and efficiently aid in judging progress towards achieving site groundwater restoration goals.

3. Present/future institutional controls need to be employed to help ensure remediation success. The effectiveness of existing land and groundwater use restrictions needs to be further evaluated.

4. During the June 28, 2005 site inspection, KMC representatives made note of a strip of land immediately south of Brown Deer Road, but north of the Union Pacific Railroad tracks. This land is noted in the RD/RA Consent Decree as being part of the site. However, KMC representatives believe that no former creosote operations were conducted here, and ask if this slice of land could be excluded from lands subject to remedial action.

5. Two or three monitoring wells associated with treatment gate zone #1 appeared to have undergone some subsidence, to the extent that the well casing may need to be re-sealed.

Table 2: Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. More efficient operation of the funnel and gate groundwater system	N	Y
2. PRP representatives raise the matter of modifying/streamlining the groundwater monitoring network	N	Y
3. How can institutional controls help ensure remedy success?	Y	Y
4. Should a strip of land immediately south of Brown Deer Road and north of the Union Pacific Railroad tracks which may not have been subject to active creosote plant operations be included within the RD/RA Consent Decree?	N	N
5. Monitoring well casing subsidence noted	Y	Y

IX. Recommendations and Follow-up Actions

Following along with items discussed in "Issues", above, these site recommendations and follow-up actions might best lend themselves to ensuring continued protectiveness:

Issue #1 - More efficient operation of the funnel and gate groundwater system
Recommendation for Issue # 1 -
The treatment capacity of the final two gates is at present underutilized. But, the gradient in this area of the aquifer is only very slight, such that it may be some time before contaminated groundwater near wells MW-33/34 reaches the final gate pairs. Could another treatment gate be installed near this point of higher aquifer contamination? Could flow be induced to move towards the final two gate pairs, either by extracting water near those gates, and injecting it back near the MW-33/34 vicinity. If trees were planted near the final two gate pairs, could they serve as "natural pumps" in drawing water towards this area, and better use the treatment capacity? The parties may not be able to resolve this matter before issuance of this report, but the parties will continue to consider how/if the aquifer cleanup question may be managed more efficiently, if possible.

Issue #2 - PRP representatives raise the matter of modifying/streamlining the groundwater monitoring network
Recommendation for Issue #2 -
U.S. EPA is aware of developing guidance in this area, and is cognizant of the need to make adjustments towards "long term monitoring optimization". U.S. EPA will review this matter in coordination with WDNR. As with the previous issue, final decision may not necessarily be reached prior to issuance of this report, but the agencies will continue to consider this item.
Issue #3 - How can institutional controls help ensure remediation success?
Recommendation for Issue #3 -
EPA and the parties need to examine the institutional controls currently in place to make sure they are adequate, protective, in effect on the appropriate properties, enforceable and run with the land. Kerr McGee has observed that the parties revisited land use controls and executed revised and expanded proprietary controls in 2000, but there is currently no analysis of what restrictions were recorded on what specific properties, whether other interests in the particular property (e.g. pre-existing easements) need to be subordinated, whether title commitments are needed and whether there are properties at the site that do not have restrictions in place.
U.S. EPA will explore this issue with other parties.
Issue #4 - Should a strip of land immediately south of Brown Deer Road and north of the Union Pacific Railroad tracks which may not have been subject to active creosote plant operations be included within the RD/RA Consent Decree?
Recommendation for Issue #4 -

In coordination with WDNR, U.S. EPA will consider this issue. Discussion with U.S. DOJ may prove warranted. A letter developed by the parties bound to the RD/RA Consent Decree, and clarifying whether the Decree should properly include/exclude such land may be appropriate.
Issue #5 - Monitoring well casing subsidence noted
Recommendation for Issue #5 -
Well casing construction should be such that one avoids the well serving as a conduit for surface water infiltration. This was discussed in the field with KMC/Weston representatives, and it is EPA's impression that all parties agree this is a needed maintenance item.
U.S. EPA will attempt to send out all needed follow-up correspondence regarding the issues noted above within 45 days of issuance of this Five Year Review Report. A goal for Recommendation resolution pertaining to all issues is set for 180 days from issuance of this Review Report.

B. **Recommendations and Follow Up Actions**

Issue	Recommendation and Followup Action	Party Responsible	Oversight Agency	Mile-stone Date	Affects Current Protectiveness	Affects Future Protectiveness
Soils on former wood treating facility were remediated to industrial and recreational standards and require land use restrictions. Sediments in the former channel of the Lower Menomonee river will be cleaned up to recreational standards. Groundwater use on the former wood treating facility is prohibited	Develop IC Plan to evaluate effectiveness of existing institutional controls	PRP or EPA	EPA	6 mos	No	Yes
Sediments in the former channel of the Lower Menomonee river south of the wood preserving plant will be cleaned up to recreational standards	Develop IC Plan to evaluate effectiveness of existing institutional controls	PRP or EPA	EPA	6 mos	No	Yes

U.S. EPA will attempt to send out all needed follow-up correspondence regarding the issues noted above within 45 days of issuance of this Five Year Review Report. A goal for Recommendation resolution pertaining to all issues is set for 180 days from issuance of this Review Report.

X. Protectiveness Statement

The remedy is functioning as intended and is expected to be protective upon completion of the remedy. Long term protectiveness requires achievement of groundwater cleanup standards, sediment cleanup standards, and the recording, monitoring and compliance with institutional controls.

Construction has been completed for soils treatment and the groundwater funnel and gate system only. Sediment management is not yet complete for the final two stream segments, Segments 4 and 5.

Therefore, while all immediate threats have been eliminated and there are no current exposures or threats to human health and the environment, the remedy is expected to be protective upon completion of all remedial measures.

The remedy implemented for soils treatment via low temperature thermal desorption, and the funnel and gate groundwater collection/treatment system, is protective of Human Health and the Environment, all immediate health threats have been addressed, and there are no exposures of concern. For the groundwater funnel and gate system, the parties have identified a pocket of contaminated groundwater in between active gate areas as an issue, and will explore relatively simple options in trying to enhance the efficiency of capture of this "pocket" of contamination. However, this desire to improve system efficiency does not mean that the groundwater funnel and gate system is not protective of overall remedial goals. The soils and groundwater management portions of the overall site remedy are protective.

For sediment management, the remedy is expected to be protective upon completion. Initial review of work to date in completed Segments 1-3 indicate that remedial goals for PAH cleanup in the stream bed has been attained, and the desirable features, such as pools and riffle areas, that were introduced into new channel areas, appear well established. Continued observation and care must be taken with regard to revegetation survival rates, and control of invasive species. However, initial results for Segments 1-3 also appear encouraging in this regard. The technologies selected for sediment management appear to be protective of human health and the environment. Once design is complete, and all stream sediment management remedial technologies are installed and operating, a following review report can deal more definitively with the degree of success of the sediment management efforts.

XI. Next Review

The next Five Year Review will be completed within five years of signature of this report, which would be by approximately Fall 2010.

REFERENCE MATERIALS

1. Quarterly Groundwater Monitoring Reports as compiled by Weston Solutions, Inc., for the Moss-American Site. Mid- 2000 to the present.

2. Monthly Progress Reports as compiled by Weston Solutions, Inc., on behalf of Kerr-McGee Chemical LLC. Mid-2000 to the present.

3. CH2MHILL periodic reports on oversight of soil treatment using thermal desorption treatment technology. Mid-2001 to early 2002. Summary report of soil remediation submitted at end of work phase.

4. Annual Reports to the Court concerning site progress as compiled by counsel for Kerr-McGee Chemical LLC. 2001-2004.

5. CH2MHILL periodic reports on oversight of sediment management remediation. Fall 2002 to early 2005. Summary report of sediment remediation to date submitted at end of work phase for stream Segment 3.

6. Sediment Remediation Design information - submitted in final form in summer 2002 for stream Segment 1 and in early winter 2004 for stream Segments 2/3.

7. Soil Remediation Design information - submitted in final form in late 2000 for thermal desorption cleanup work.

8. For further information and a pictorial history of recent site construction activity, the reader is encouraged to see the following website as maintained and updated by Region 5's Community Involvement Section:

http://www.epa.gov/Region5/sites/mossamerican/index.htm

INTERVIEW RECORD

Site Name: Moss-American Site
EPA ID No.: WID039052626

Subject: Site Inspection
Time: **Date:** June 28, 2005
Type: Telephone X Visit Other
Location of Visit: Moss-American Site

Contact Made By:

Name: Russell D. Hart Title: RPM Organization: U.S. EPA - Region 5 - Superfund

Individuals Contacted:

Interviews were conducted as part of the site inspection process. For further details, please see the Site Inspection notes of the June 28, 2005 site visit which follow this section.

Name(s): Organization(s): (See Site Inspection Section, below)
Telephone No:
Fax No:
Street Address:
City, State, Zip:

Summary Of Conversation

Site Inspection Checklist

I. SITE INFORMATION

Site name: Moss-American NPL Site **Date of inspection:** June 28, 2005
Location and Region: Milwaukee, Wisconsin **EPA ID:** WID039052626
Agency, office, or company leading the five-year review: U.S. EPA - Region 5 leading five-year review process with cooperation and report input from Wisconsin DNR
Weather/temperature: Hazy, humid; approximately 90 deg. F.
Remedy Includes: (Check all that apply)

☐ Landfill cover/containment ☐ Monitored natural attenuation
X Access controls Groundwater containment
X Institutional controls ☐ Vertical barrier walls
X Groundwater pump and treatment - more specifically for this site, collection and treatment through usage of funnel and gate system
☐ Surface water collection and treatment
X Other___Contaminated soils treatment using low temperature thermal desorption. Contaminated sediments management using a combination of river reroute and new channel creation, plus dredging and continued usage of existing stream channel sections.

_____

_____

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Attachments: X Inspection team roster noted as follows:

Kerr-McGee Chemical LLC - A. Keith Watson; Nick Bock
Weston Solutions, Inc. - Thomas Graan; David Jedlika
Union Pacific Railroad - Edwin Honig
Wisconsin DNR - Thomas Wentland
U.S. EPA - Reg. 5 - Russell Hart

☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** _____ _____

_____

Name Title Date
Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
Problems, suggestions; ☐ Report attached

_____

_____

____

2. **O&M staff** _____ _____

Name Title Date

Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____

Problems, suggestions: ☐ Report attached

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency _____

Contact _____ _____ _____

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

Agency _____

Contact _____ _____ _____

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

Agency _____

Contact _____ _____ _____

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

Agency _____

Contact _____ _____ _____

Name Title Date Phone no.

Problems; suggestions; ☐ Report attached

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☐ O&M manual ☐ Readily available ☐ Up to date ☐ N/A

☐ As-built drawings ☐ Readily available ☐ Up to date ☐ N/A

X Maintenance logs X Readily available X Up to date ☐ N/A

Remarks_As will be discussed further under "Groundwater Treatment System", the treatment building has the most need for on-going maintenance records compilation.

2. **Site-Specific Health and Safety Plan** X Readily available X Up to date ☐ N/A

☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☐ N/A

Remarks__This should_likely be plural ("plans") pending on work phase. During active construction, safety plan/sign-in sheets maintained at construction trailer. For O & M, monitoring activity, Weston updates site H & S Plan as needed. During June 28, 2005 inspection, H & S update page, dated 6/16/2005 was displayed. (Update was necessary to account for the possibility of certain wild animals noted in vicinity of Little Menomonee River, which is part of the site).

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A

Remarks

4. **Permits and Service Agreements**

☐ Air discharge permit ☐ Readily available ☐ Up to date X N/A

☐ Effluent discharge ☐ Readily available ☐ Up to date X N/A

☐ Waste disposal, POTW ☐ Readily available ☐ Up to date X N/A

☐ Other permits_____ ☐ Readily available ☐ Up to date X N/A

Remarks

5. **Gas Generation Records** ☐ Readily available ☐ Up to date XX N/A
Remarks_____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date XX N/A
Remarks_____

7. **Groundwater Monitoring Records** ☐ Readily available ☐ Up to date ☐ N/A
Remarks___Agencies are sent quarterly reports as regards funnel and gate treatment performance and associated monitoring wells that track response of the plume of contamination. Results are presented elsewhere in this document.

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date XX N/A
Remarks_____

9. **Discharge Compliance Records**
☐ Air ☐ Readily available ☐ Up to date XX N/A
☐ Water (effluent) ☐ Readily available ☐ Up to date XX N/A
Remarks_____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☐ N/A
Remarks__Until recently, there had been dual access records to some degree. Visitors wanting to see the groundwater treatment building would have had to first check in with Union Pacific security area, and then proceed to treatment building. In recent weeks, changing business circumstances have reduced active vehicle operations once conducted by Union Pacific.

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house XX Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other___Per discussion during 6/28/2005 five year review inspection, most O & M activities are contracted by KMC to Weston Solutions as firm with system design/consultant expertise. The task of O & M for invasive species plant control via periodic herbicide application and "as -needed" mowing in vicinity of groundwater treatment building is in turn subcontracted to True Green Chemical.

2. **O&M Cost Records**

☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: __Discussion - The primary site activity which involves on-going O & M consideration is the running of the groundwater treatment building. On the question of "have such costs been trending unusually high", the reply was - not from a systems standpoint. There were a couple episodes of early part failure, in particular a bearing failure that caused blower outage. However, Weston/KMC attribute this to unfortunate experience with particular equipment items, rather than difficulty/added cost in running groundwater treatment measures as a whole.

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map XX Gates secured ☐ N/A
Remarks__Aside from locks which KMC/Weston maintain on the groundwater treatment building and monitoring wells, major site property owners Union Pacific and Milwaukee County both maintain gates and fencing around the site perimeter in general. No instances of obvious fence damage or fence vandalism are known.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by)

Frequency

Responsible party/agency

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☐ No ☐ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map XX No vandalism evident
Remarks

2. **Land use changes on site** ☐ N/A
Remarks___Until recent weeks, Union Pacific had operated for 15+ years a system of new/rental vehicle off-loading/storage as Milwaukee area auto dealers had vehicles arrive in the Milwaukee area before transit to various car lots. However, this activity has been curtailed recently. According to Union Pacific representative, this does not change site zoning nor perceived presumption of industrial activity on this portion of the site.

3. **Land use changes off site** ☐ N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☐ N/A

1.**Roads damaged**☐ Location shown on site map XX Roads adequate☐ N/A
Remarks__Basically, there is a two-fold need for roads on the Moss-American site. A more permanent need occurs for gravel roads to travel to the various funnel and gate zones, since

seasonally the groundwater table can be high and site conditions can be quite muddy. On a temporary basis, (1-2 construction seasons) access roads are needed to support sediment remediation measures. After work completion involving a given stream segment, access roads are largely reclaimed and the former road bed replanted.

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS ☐ Applicable XX N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable XX N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES XX Applicable ☐ N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines	☐ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A

Remarks__Moss-American does not use extraction wells. Rather, the means of contaminated groundwater collection is to employ a funnel/gate system, which introduced more permeable soil materials into the overall soil mix so as to preferentially induce groundwater flow into the "gate" area. Air is injected into the aquifer so as to help induce biota growth which will aid in consuming groundwater contaminants of concern. The most important maintenance item to date is that the injected air may not have sufficient contact time with the aquifer in case dry soil conditions cause a "crack" allowing for a preferential escape pathway to the atmosphere, instead of preferred aquifer contact. (The groundwater table is relatively shallow; sometimes varying from a few feet to 9-12' bgs). Hence, small amounts of other site soils are occasionally needed to "patch" such minor soil fissures.

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

XX Good condition ☐ Needs Maintenance

Remarks__The condition of the piping carrying air from blowers in the treatment building into the aquifer is obviously of importance. Weston Solutions reports that in the 4-5 years of operation to date, no cracks or undue failure of the air lines has occurred.

3. **Spare Parts and Equipment**

XX Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks__Groundwater-related items for which a frequent maintenance schedule is most needed consist of air filters for blowers, V-belts for motors, and blower motor mufflers for noise suppression. Minor oiling and lubrication is needed on a monthly basis. All such blower device maintenance is recorded in a log book. If no other activity other than lubrication is performed, the log book notation simply says "blower maintenance". If another item is needed - such as air filter, V-belt, noise muffler replacement, etc., a brief notation to this effect is noted. Weston keeps some parts within the treatment building; other routine items are available within one day. There is some capability within the system that if one blower motor is down, there can be some shifting via the electric panel so that on a temporary basis one of the remaining motors can do cross feed air injection into other air lines normally served by the motor which may be down for servicing.

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable XX N/A

C. Treatment System ☐ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☐ Air stripping ☐ Carbon adsorbers
☐
Filters_____
_____
☐ Additive (*e.g.*, chelation agent, flocculent)_____
XX Others__Three air blowers located in the site groundwater treatment building supply air into the aquifer to help in-situ biodegradation of groundwater organic contaminants take place.
_____
_
☐ Good condition ☐ Needs Maintenance
☐ Sampling ports properly marked and functional
☐ Sampling/maintenance log displayed and up to date
☐ Equipment properly identified
☐ Quantity of groundwater treated annually_____
☐ Quantity of surface water treated annually_____
Remarks_____
_____
_____
_____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A XX Good condition ☐ Needs Maintenance
Remarks__Transformer is also a part of the treatment building electrical system, in addition to the electrical panels. Block out/tag out features are also a part of the system for safety reasons.
_____
—
_____
_____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenanc e
Remarks_____
_____
_____
_____

4. **Discharge Structure and Appurtenances**

XX N/A ☐ Good condition ☐ Needs Maintenance

Remarks_____

5. **Treatment Building(s)**

☐ N/A XX Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks__Houses blowers, blower motors, electrical panels, filing cabinets to store maintenance and health and safety items associated with the groundwater portion of the remedy - such as monitoring well sampling procedures. One "lesson learned" item regarding HVAC concerns for the treatment building: While there was initial concern about supplying external heat for winter time operations, experience has shown that the build up of heat from the blower motors during cold weather months is enough to keep heat levels within the treatment building tolerable. What was necessary is that more roof exhaust portals were added to aid building conditions during the summer months.

6. **Monitoring Wells** (funnel and gate treatment remedy)

XX Properly secured/locked XX Functioning XX Routinely sampled ☐ Good condition

XX All required wells located XX Needs Maintenance ☐ N/A

Remarks__During the June 28, 2005 site inspection, the WDNR representative noted that 2-3 monitoring wells associated with treatment gate zone #1 appeared to have undergone some subsidence, to the extent that the well casing may need to be re-sealed. Obviously, the thing to be avoided is the well serving as a conduit for surface water infiltration. This was discussed in the field with KMC/Weston representatives, and it is EPA's impression that all parties agree this is a needed maintenance item.

D. Monitoring Data		
1.	Monitoring Data XX Is routinely submitted on time	XX Is of acceptable quality
2.	Monitoring data suggests: XX Groundwater plume is effectively contained	☐ Contaminant concentrations are declining

X. OTHER REMEDIES

The June 28, 2005 site inspection also included a look at areas in proximity to the Little Menomonee River where sediment management activities have been underway since 2002. A combination of new channel creation and river reouting with increased sinuosity has been conducted. Dredging has supplemented sediment management efforts in runs of the river where rerouting is impracticable, such as in the vicinity of roadway or railroad bridges, and/or in zones where the floodplain was constricted to the extent that new channel creation would have been disruptive of area residences or commercial establishments.

Stream stabilization, access road creation and dismantlement, invasive species control, and revegetation efforts are all important aspects of sediment management. Hence the site inspection included a look at places where access roads had been installed and have now been taken out and replanted, zones of herbicide application for invasive species control, and areas near new channel where revegetation has been attempted. The entire length of the three stream segment zones where sediment management has now been completed were not inspected "foot-by-foot"; however an effort was made to visit portions of the Little Menomonee River area where stream stabilization, access road creation and dismantlement, invasive species control, and revegetation efforts took place.

Areas visited included: - within Segment 1, near access road bridge over a section of new channel. New channel creation work and dredging was accomplished in this zone from late summer 2002 to early winter 2003. New plant growth near the stream has been particularly lush. Grasses and shrubs planted over a former access road and a section of former stream channel seems well established. Some of the newly planted trees have leafed out well; others had no leaf canopy, though some sprouting near the tree base occurred. As established by written agreement, a desired new vegetation survival rate after three growing seasons is desired. Failure to attain the survival rate means further planting is needed. Weston representatives indicated they intended to retain the services of horticulturalists in the near future to conduct a survey to see which of the previously planted trees have in fact survived, and which need replanting. The agencies look forward to results of this effort.

The next area visited was within Segment 2. Sediment management work in both Segments 2 and 3 was conducted in two phases in 2004. New plant growth was not in general as well-established yet as compared to Segment 1. However, through June 2005, there have been significantly lower than normal rainfall events. New growth seemed to have taken hold well in areas where the water budget allowed this; that is, in very close proximity to the stream. Farther away from the banks, new plant growth was stunted. The parties are hopeful that more rain in the future will help promote plant growth. Features of the new channel which will hopefully lead to desirable aquatic habitat conditions were obvious - riffle zone run areas in places where gradient would allow; deeper pools, tree "traps" to help create habitat variation, etc.

Another zone within Segment 3 was also visited. This was in the Park Manor area, back up to the bicycle/hiking path bridge over the river. Similar designed stream features were in